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VOLUME 13, NUMBER 6 • JUNE, 1957

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- *Listing by Sections*
- *Alphabetical Listing*

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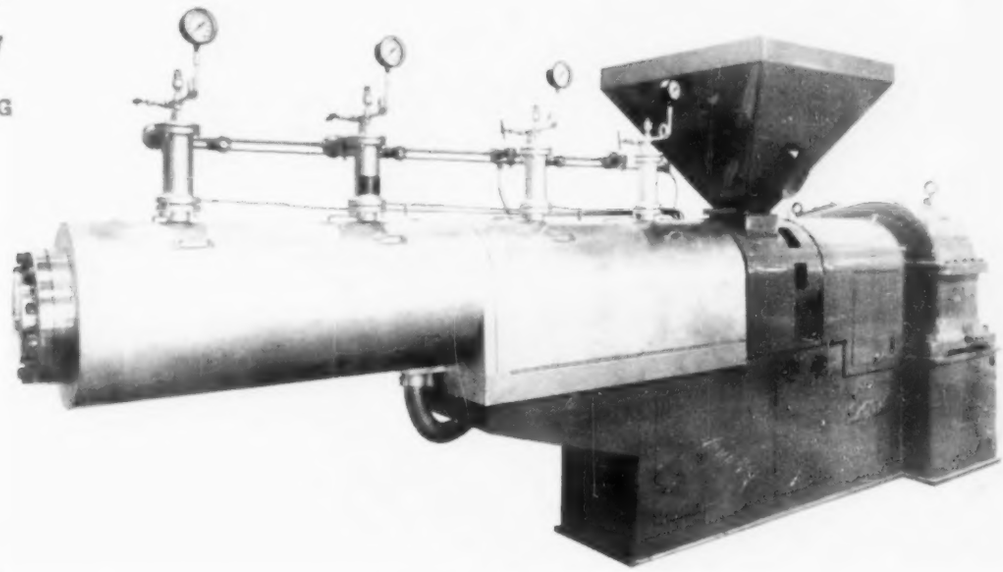

Heating Systems for Extrusion Cylinders (Story on page 425)

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.

In sealing, potting and encapsulation—

EPON® RESINS

give excellent electrical, thermal and mechanical properties, plus—

Applying Epon resin sealing compound, formulated by Epoxylite Corporation, El Monte, California, to a 400-kva transformer winding at Larsen-Hogue Electric Co., Los Angeles, Calif.

Thoxene Clamp-Coat, an Epon resin cable splicing compound, produces a weatherproof, abrasion-resistant coating with high electrical insulation. Manufactured by Woodmont Products Inc., Huntingdon Valley, Pa.

- ✓ excellent dimensional stability
- ✓ high mechanical strength
- ✓ outstanding adhesion to metal, glass, plastics
- ✓ exceptional dielectric properties

Although relatively new, the Epon resins have won an important place in electronic and electrical manufacture. Their applications are manifold . . . in printed circuit laminates, transformer and motor sealing compounds, potting compounds for components and subassemblies, protective enamels, adhesives, tool and die materials.

For potting and encapsulating—the excellent dimensional stability of Epon resins, which can, for example, withstand solder bath temperatures without ill effect, and their outstanding adhesion to metals and glass assures airtight enclosure of delicate components and vacuum tubes

As adhesives—solvent-free Epon resin formulations cure at room temperature with contact pressure alone; form powerful bonds between glass, metal, wood or plastic.

As sealing compounds—varnishes and enamels based on Epon resins provide excellent moisture sealing plus outstanding resistance to solvents and chemicals, even at elevated temperatures.

For laminating—Epon resins laid up with inert fibrous fillers produce base laminates that have superior dielectric properties and can be sheared, punched, drilled and bath soldered.

Write for information on the use of Epon resins in electrical and electronic applications.

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Vol. II, No. 3

POLYETHYLENE PROCESSING TIPS

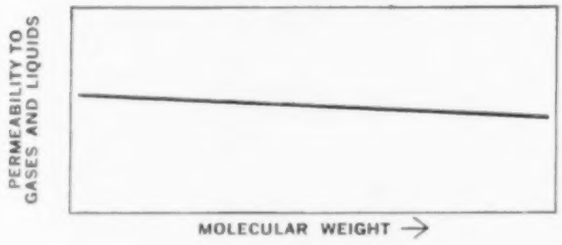
HOW MOLECULAR WEIGHT AFFECTS POLYETHYLENE PROPERTIES

Molecular weight is one of the three most important resin characteristics that determine end-use properties of polyethylene. *Density* and *molecular weight distribution* are two others.

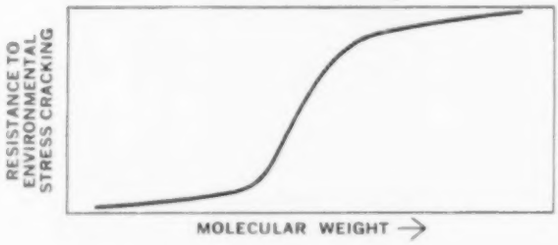
Melt Index is an approximate measure of molecular weight. Resins with low molecular weight have high melt index values, and vice versa.

The following graphs show the effect of increasing molecular weight, (or decreasing melt index) assuming that density and molecular weight distribution remain constant. In practice, of course, these characteristics are different for different resins so the effects of all three must be considered.

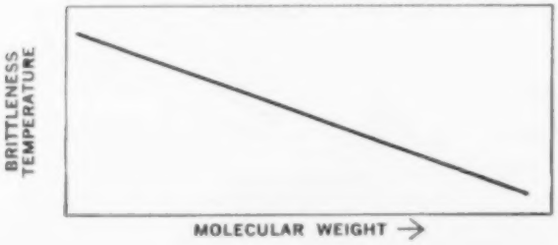
Permeability



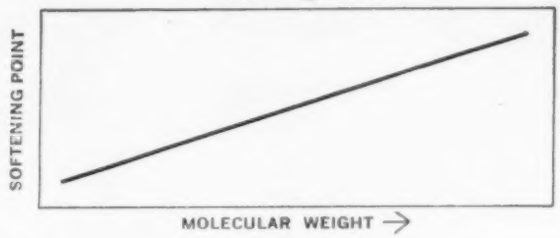
Resistance to Environmental Stress Cracking



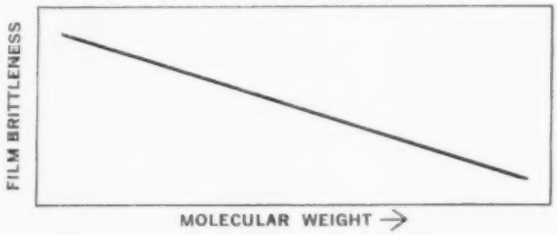
Low Temperature Brittleness



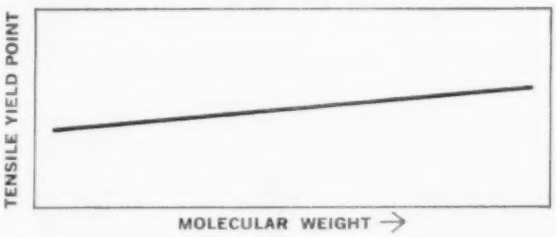
Softening Point



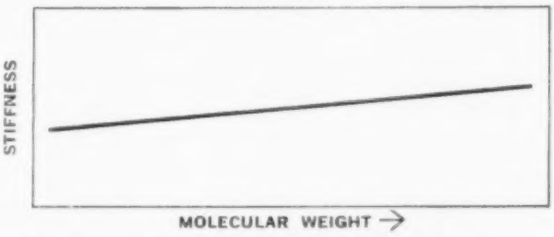
Film Brittleness



Tensile Yield Point



Stiffness



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In both parts of the Roster. If our records are not right please let us know.

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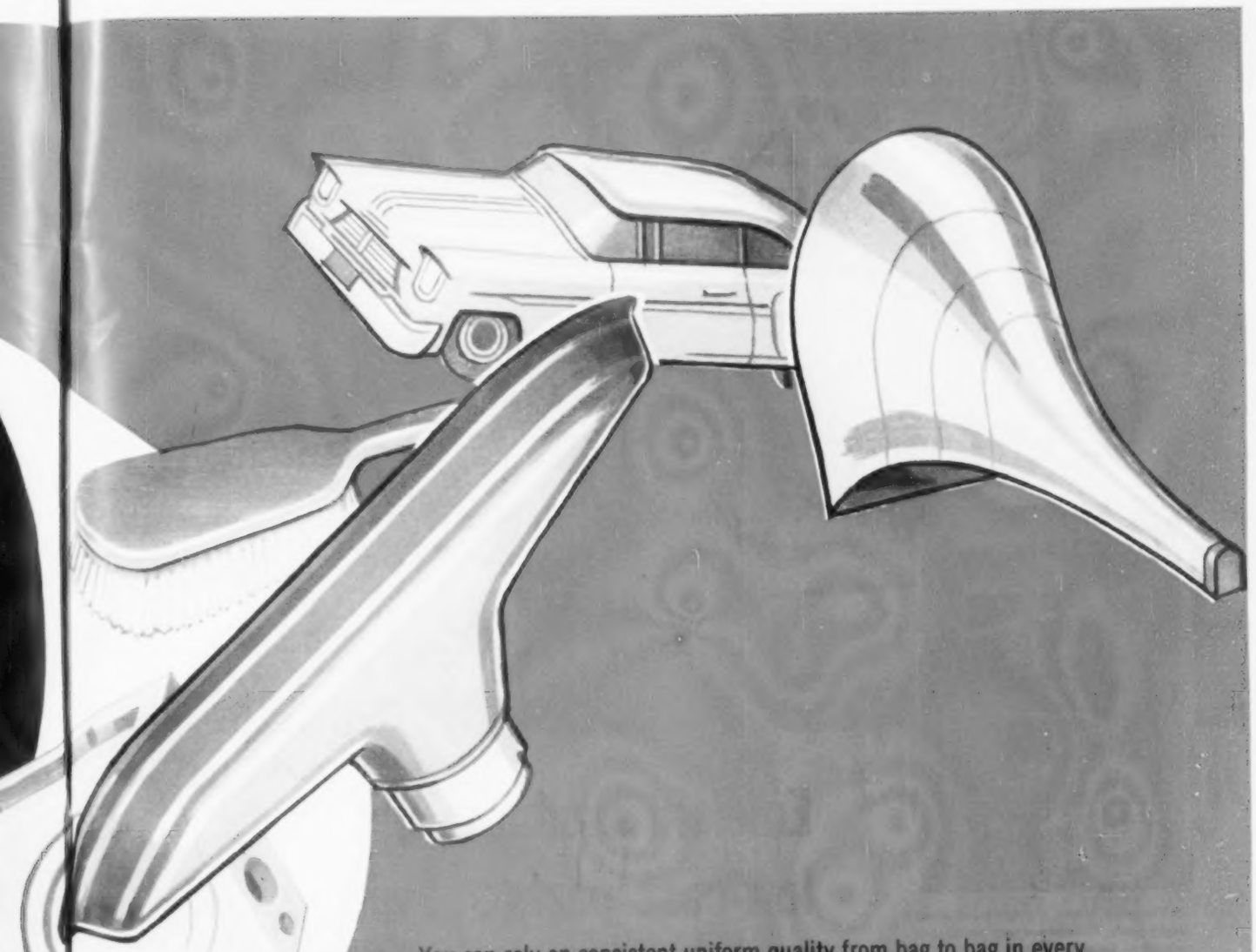

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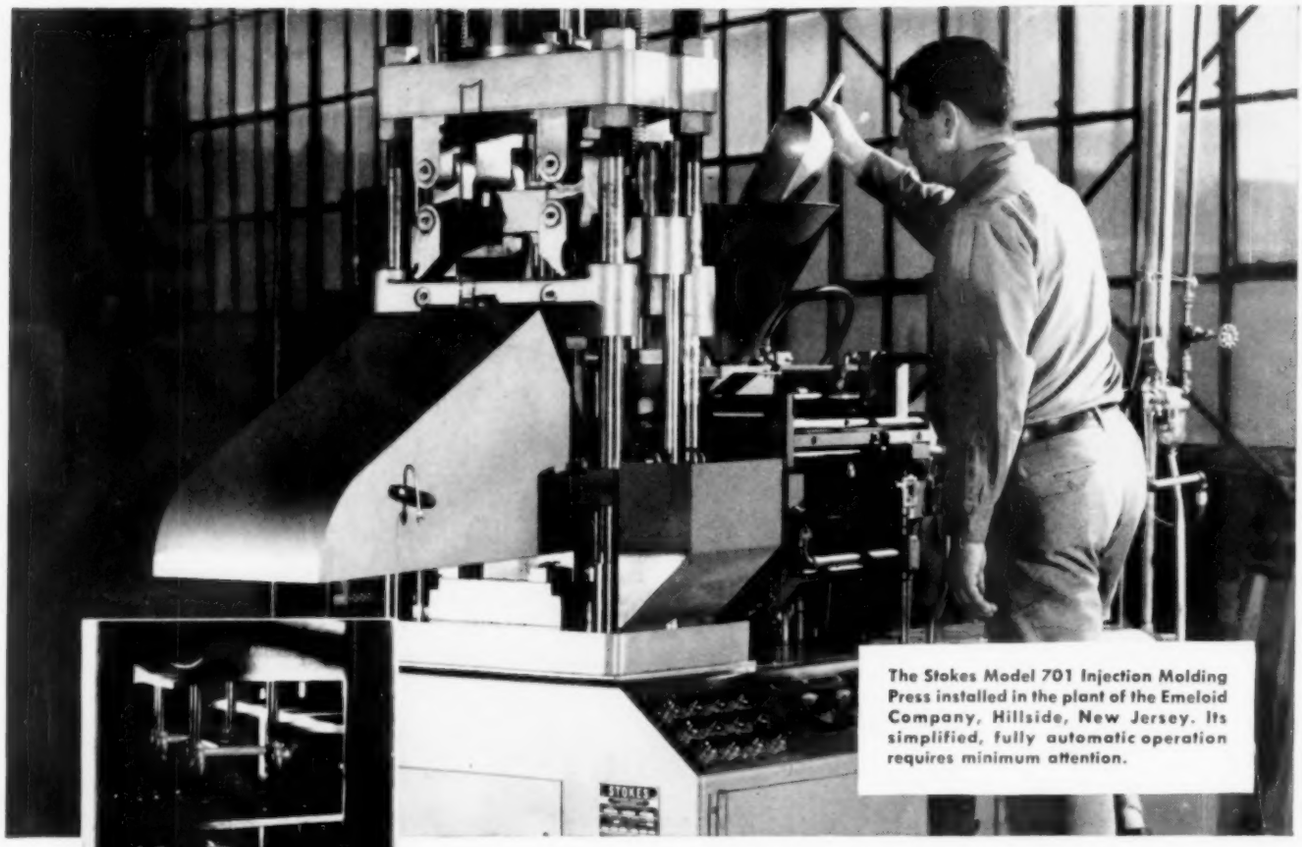

The Stokes Model 701 Injection Molding Press installed in the plant of the Emeloid Company, Hillside, New Jersey. Its simplified, fully automatic operation requires minimum attention.

A close-up of the die table showing eight parts, simultaneously produced, about to be stripped off.

Emeloid produces better, low-cost parts . . . with a Stokes Model 701 Press

Fully automatic injection molding with a Stokes 701 enables this custom molder to increase production by 20%.

The Emeloid Co., Inc., has been a custom molder of plastic products since 1919—with over 25 years' experience in injection molding. They recently installed a Stokes 701 Automatic Injection Press for high speed production of pushbuttons for home appliances. Result: a 20% increase in production with the same number of mold cavities.

Fully automatic operation of the Stokes 701 enables Emeloid to produce better parts—with a lower reject rate and higher production yield. The better quality enables them to perform faster, more satisfactory after-operations such as the hot stampings of identification legends.

Extremely simple tooling of the 701 requires less expensive molds—reduces changeover costs. The precision operation provides a higher degree of uniformity and quality of finished parts. This press requires less attention, produces on faster cycles and with higher efficiency.

Stokes patented ejection system positively clears all parts and runners from the die. Secondary protection is provided by use of the more common low-pressure close. Completely self-contained, the vertical design of the 701 saves floor space—permits easy sorting and separation—facilitates mold set-up.

Write for your copy of literature on the Stokes 701—the truly automatic 2-ounce injection molding press. Ask for a Stokes production analysis on your own parts.

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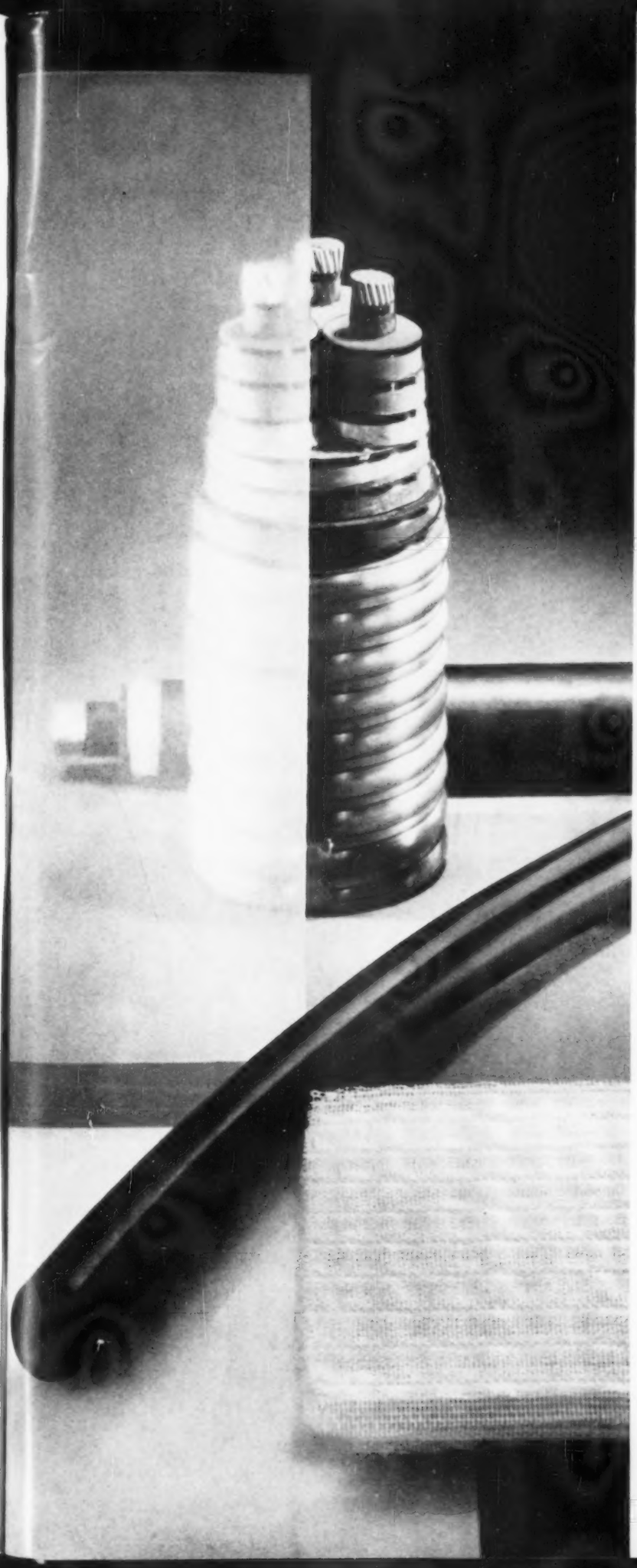
STOKES



Polyethylenes

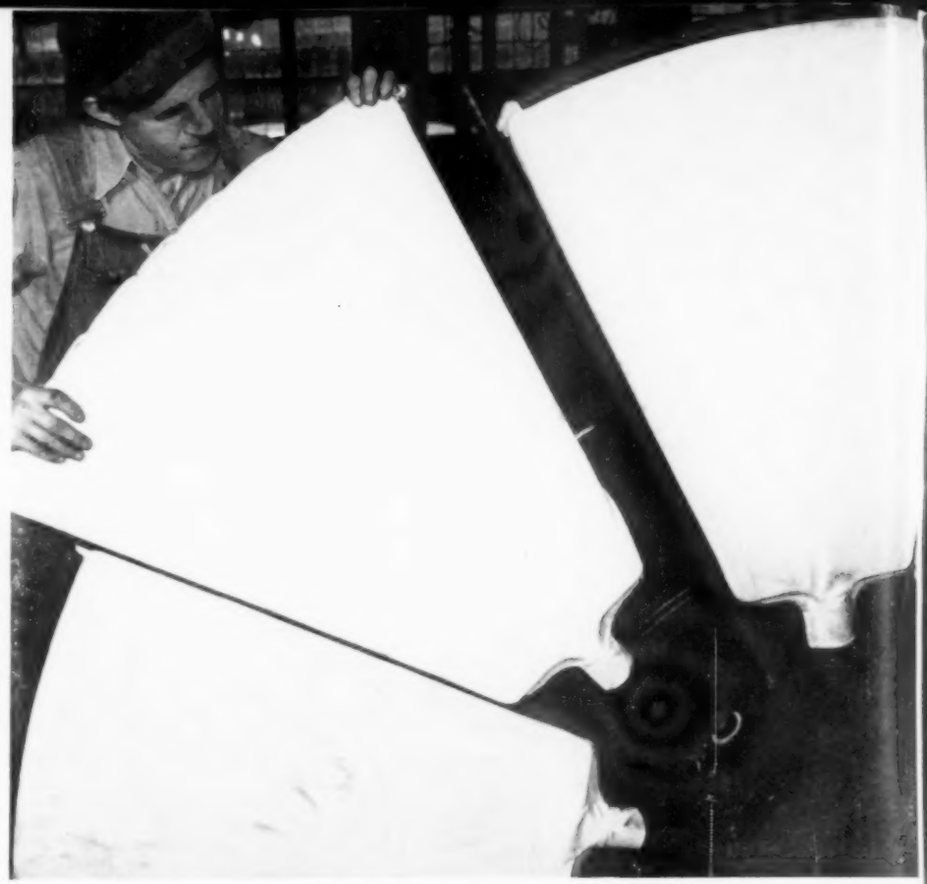
...idea-building extrusion materials

Polyethylene means more good business for extruders. It is ideal for extrusion processes. It fits perfectly into product planning. Best of all, there is a huge market for the combination of properties that polyethylene provides. To help you meet this market's many facets, Bakelite Company supplies the greatest variety of polyethylene extrusion materials, along with expert aid in putting them to best use . For examples of typical products,

see the next page

Polyethylene for Monofilaments

Extruded monofilaments of BAKELITE Brand Polyethylene have been woven into cloth. It is remarkably strong, durable, and chemical-resistant. For example, these filter bags have lasted 1000 hours compared to 80 for the previous material. They have been filtering molybdenum particles from slurry for six months and still show no signs of wearing out. They have stood up under the weight of the caked molybdenum, continual wetting and drying, and the alternate pull by vacuum and push by compressed air to loosen the cake. The polyethylene cloth is non-blinding (pores won't clog) and has cut replacement down-time considerably.

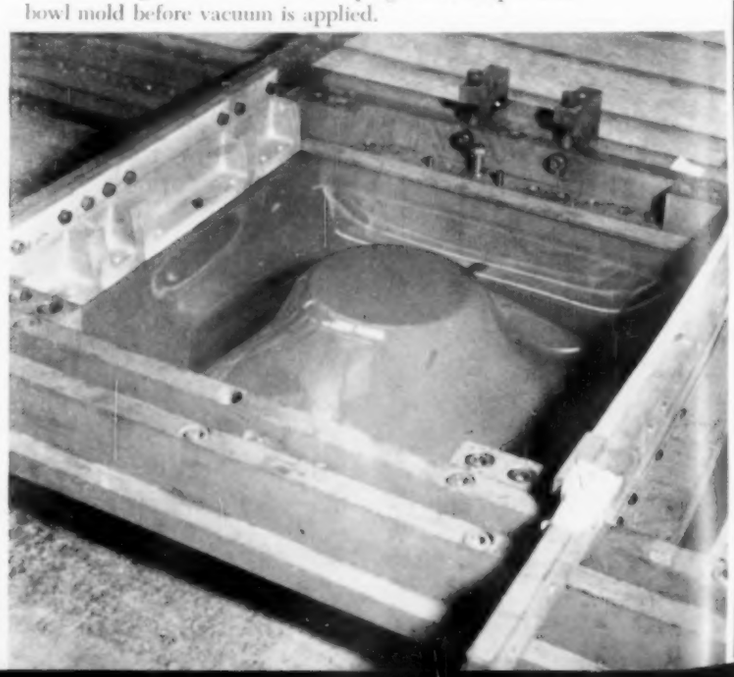


Polyethylene Sheets for vacuum forming

Extruders get a bigger bite of the boom in vacuum-forming with this Bakelite development. DFD-4030 is the first polyethylene specifically compounded for sheet extrusion and vacuum- or thermo-forming. It can be fabricated by modifying equipment now used for continuous in-line extrusion and vacuum-forming of impact styrene. Housewares offer a great potential field. BAKELITE Brand Polyethylene DFD-4030 provides high molecular weight, superior gloss, unlimited colorability, and quick, trouble-free processing.

Notice the high gloss of the polyethylene sheet being placed in the clamping frame of the vacuum-forming machine.

After heating, the sheet in its clamping frame drapes over bowl mold before vacuum is applied.



Polyethylene wire and cable covering

These snow-covered telephone lines in the mountains of Washington were installed in 1950. Their extruded polyethylene insulation shows no deterioration, despite temperatures from 40 degrees below zero to 115 above. The light weight of polyethylene is an aid to installation, especially in terrain like this. The electrical insulating values are so good that lines can be close together without danger of interference. This saves adding crossarms when new lines are installed. Extruded BAKELITE Brand Polyethylene has been used for wire and cable applications ranging from the newest Atlantic cable to television lead-in, and meets the standards of all leading associations.

Polyethylene water pipe

A big market exists for water supply and irrigation pipe extruded from BAKELITE Brand Polyethylene because this pipe is light, flexible, noncorroding, and easy to install. You can handle it with the simplest tools, cut it with a knife. Flexibility permits the pipe to bend around curves and corners, and makes it resistant to freeze-up. Virgin BAKELITE Brand Polyethylene is acknowledged as a superior material for water pipe because it is specifically engineered to meet all the established standards of quality and is backed by eight years of field experience.

These are some of the leading developments in the extrusion of BAKELITE *Brand Polyethylene. A variety of compounds is formulated for a variety of applications. To keep informed, contact your Bakelite Company representative or write Dept YB-171, giving the product categories in which you are most interested.*

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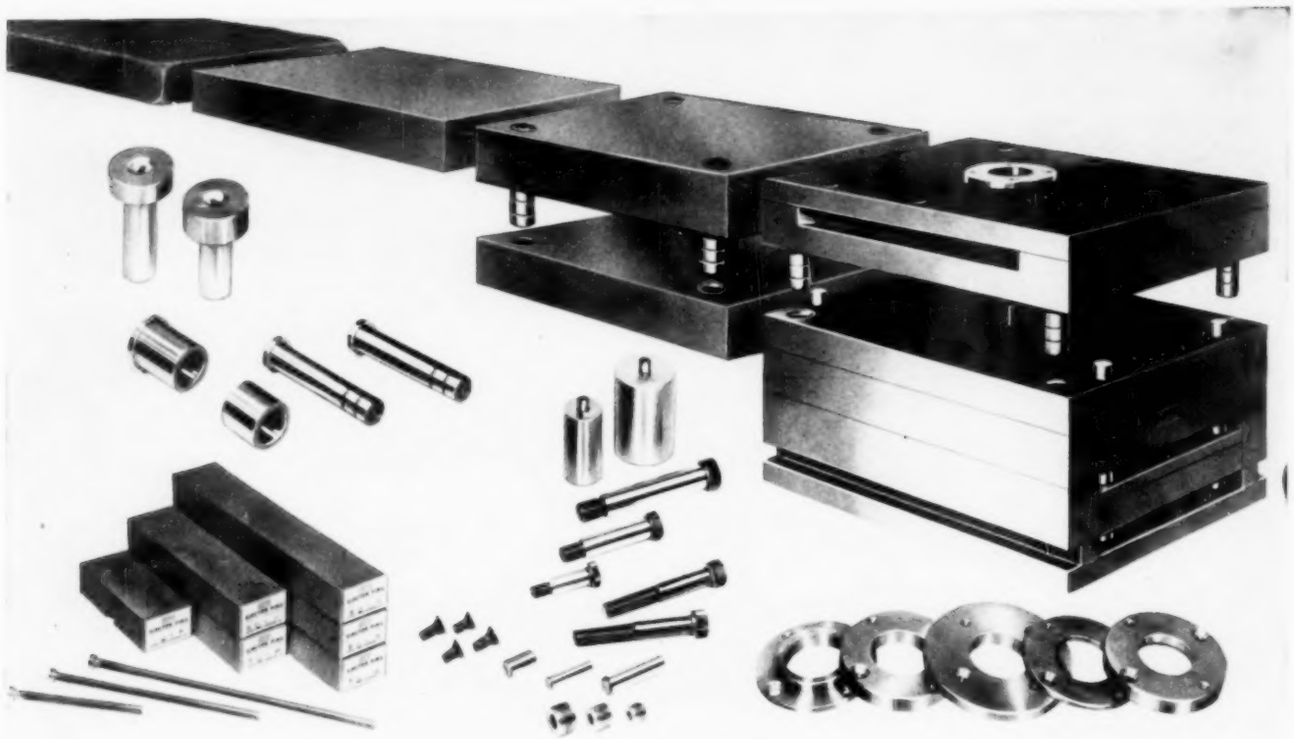

PROGRESS THROUGH STANDARDS

. . . and how DME "helped"

The history of economy in modern business has been directly related to the history of Standardization. One of the major elements affecting the economic production of finished plastic parts is the high initial cost of the mold. A progressive step in reducing mold cost, without sacrificing the high quality required, has been successfully achieved through Standardization.

When D-M-E originated Standard Mold Bases and their component parts in 1942, it provided the answer to the rapidly growing demand for high quality molds that would maintain and promote the economic advantages of plastic parts.

Through large volume purchases of quality steel in standard sizes and specialized production facilities, D-M-E was able to produce and supply high quality Standard Mold Bases to mold makers and molders at such great savings in cost and time that the benefits of Standardization were quickly realized by the Industry.

Today D-M-E produces twenty-eight different sizes of Standard Mold Bases, from 9" x 8" to 23¾" x 35½", in either D-M-E No. 1 or No. 2 Steel, with a wide range of cavity plate thicknesses to satisfy the diversified demands required. In addition, over 2,000 finished component parts of the same high quality are available to provide additional savings in service as well as in the product.

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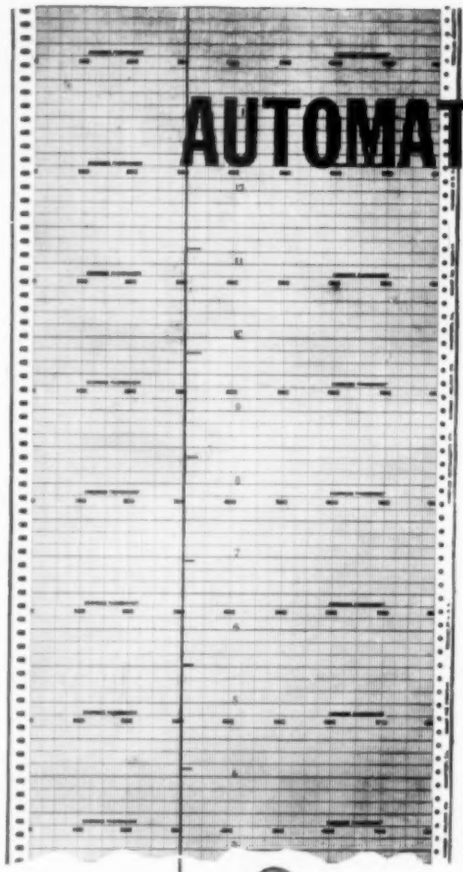

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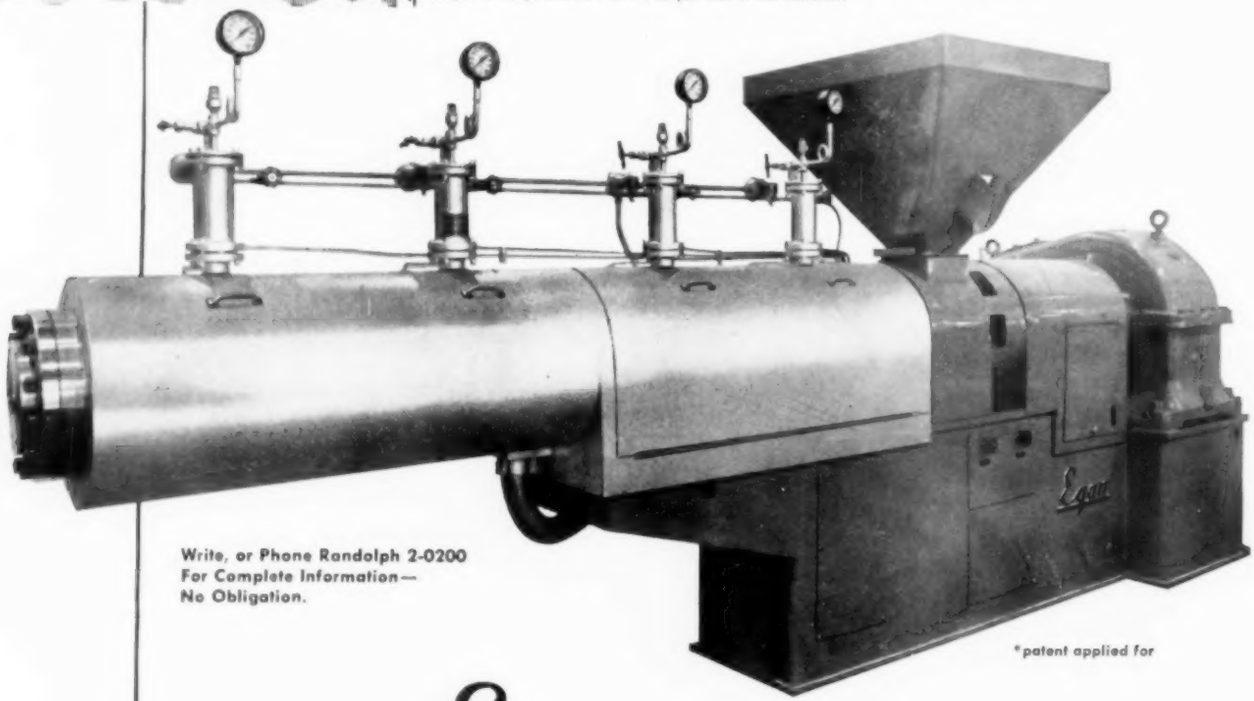
The strip chart reproduced at left shows actual material temperatures recorded during a typical day-long production run. Readings were obtained by inserting a thermocouple in the plastic melt at the output end of the extruder.



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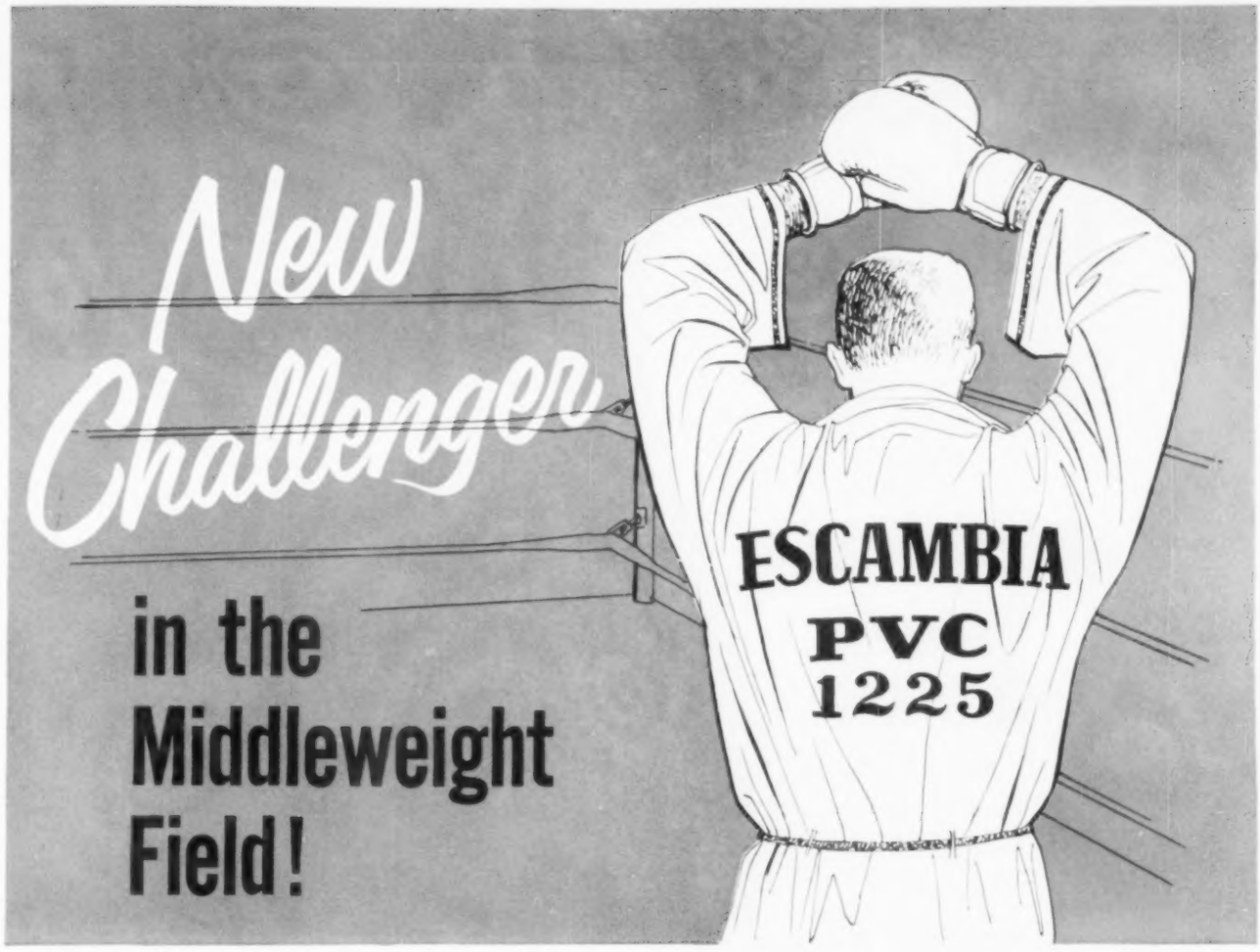

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Write for detailed information to Monsanto Chemical Company, Plastics Division, Room 1873, Springfield 2, Mass.

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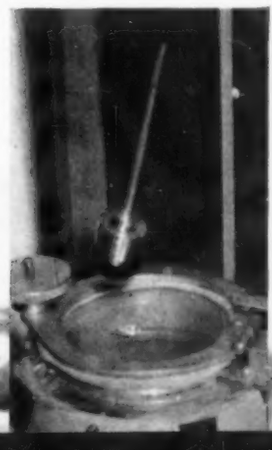

TOUGH-TESTED

At Monsanto Research and Testing Laboratories, a weight-loaded dart is repeatedly dropped on film extruded from Monsanto Polyethylene resin. This is one of many tests to maintain the highest levels in toughness for packaging and other uses.

Here's all you need to install flexible pipe of

TENITE POLYETHYLENE

Polyethylene pipe is a booming new market for the plastics industry. For example—farmers, homeowners, and industry are finding numerous jobs for pipe made of Tenite Polyethylene because of the specific advantages it offers as a material for cold-water lines. Polyethylene pipe is now the *preferred* material for these jobs and is no longer considered a mere substitute for metal pipe.

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POLYETHYLENE
an Eastman plastic

1932—EASTMAN'S 25TH YEAR IN PLASTICS—1957

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OFFERS

- superior extrusion characteristics
- superior toughness and melt stiffness

"ZYTEL" 42 IS DIFFERENT

ZYTEL 42 is specially formulated for extruding and blow-molding. Not only does it offer superior viscosity and flow properties in the molten state, but in addition to these unique properties, it retains the outstanding qualities of high strength, abrasion resistance and high softening temperature found in ZYTEL 101. Further, ZYTEL 42 offers higher impact strength, and its superior melt stability now makes control of the extrusion possible.

APPLICATIONS OF EXTRUDED "ZYTEL" 42

This new formulation can be used for extruded shapes of many varieties as well as for tubing, rod, pipe and laminates. Extruded sheeting of ZYTEL 42 is ideal for stamped items, and film of ZYTEL 42 can be laminated to paper, foil and to other films. Its greater melt stiffness makes it possible to blow-mold tough, strong bottles of ZYTEL 42, without special equipment, for containers for cosmetics, pharmaceuticals and aerosol sprays. For instance, new high-style, dry-colored bottles that are blow-molded are so tough they bounce when dropped. Heat tests have proved their ability to withstand high internal pressures without rupture or valve breakage.

OTHER APPLICATIONS

In other applications, extrusions of ZYTEL 42 have been used to make such items as washers, aircraft grommets, and bearings. Tubing of ZYTEL 42 is used in a unique automobile lubrication network which the motorist operates by pushing a button. ZYTEL 42 proves its ability to withstand extreme flexing on a wind-up reel used as an actuator rod inside a retractable auto radio antenna.

PROPERTIES OF "ZYTEL" 42

This table shows some of the superior properties of ZYTEL 42. In general, articles and shapes extruded of it are characterized by form stability at high temperatures, toughness, abrasion resistance and chemical resistance. ZYTEL 42 can readily be handled by the usual thermoplastic extrusion techniques.

PROPERTY	ZYTEL 42
Tensile strength	12,200 lb/sq. in at 73° F.
Elongation	150% at 73° F.
Stiffness	200,000 lb/sq. in at 73° F.
Hardness, Rockwell	R118
Flow temperature	480° F.
Heat distortion temp.	
264 lb. sq. in.	150° F.
66 lb. sq. in.	360° F.

Specify the new Du Pont ZYTEL 42 for extruded and blow-molded products and take advantage of the special properties this resin has to offer.

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Type of Business

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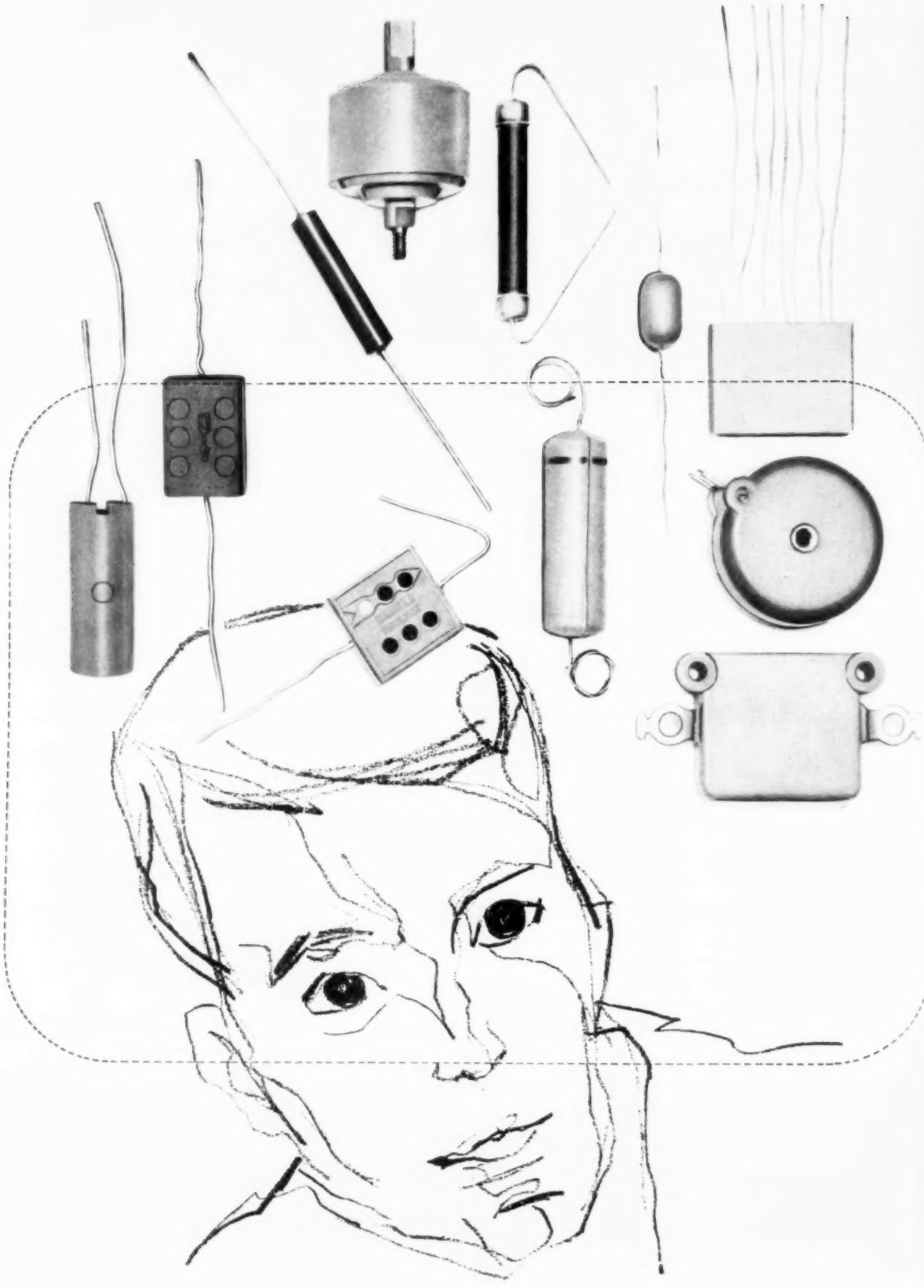

TREMENDOUS PRODUCTION SAVINGS OF **AUTOMATION** COME TO TV SET ASSEMBLY THANKS TO PLASKON® ALKYD

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More and more manufacturers of TV sets are finding that PLASKON Alkyd 417 putty material offers the best combination of physical and electrical properties required for final assembly-line automation. This opens the door not only to substantial savings in production, but to better-performing precision parts as well. Today, PLASKON Alkyds are widely used in the encasement of such important components as capacitors, resistors and toridal coils.

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1. *Tuner Board* (Alkyd 430): extreme dimensional stability; uniform, close tolerances; high rate of production.
2. *Tuner Segment* (Alkyd 420): saves machining costs; gives increased electrical and moisture resistance.
3. *Power Tube Socket* (Alkyd 422): permits rapid mass-production schedules; has high dimensional stability.

If *you* are having performance problems that might be solved by better electrical insulating materials . . . you should know more about PLASKON Alkyds. *Write today* for complete information!

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CRUCIBLE CSM 2 mold in press at Pro-phy-lac-tic Brush Co., Florence, Mass. The mold, built by Eagle Tool & Machine Co., Hillside, New Jersey, produces vegetable pans for Hotpoint refrigerators.

why **CRUCIBLE CSM 2**

is chosen for so many big molds . . .

One reason is that CRUCIBLE CSM 2 is always uniform in structure and composition. It's got to be. For the quality of every *heat* is controlled by Quantometer analysis . . . and every *piece*, regardless of size, is ultrasonically inspected. This means superior machining and polishing characteristics.

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CRUCIBLE first name in special purpose steels

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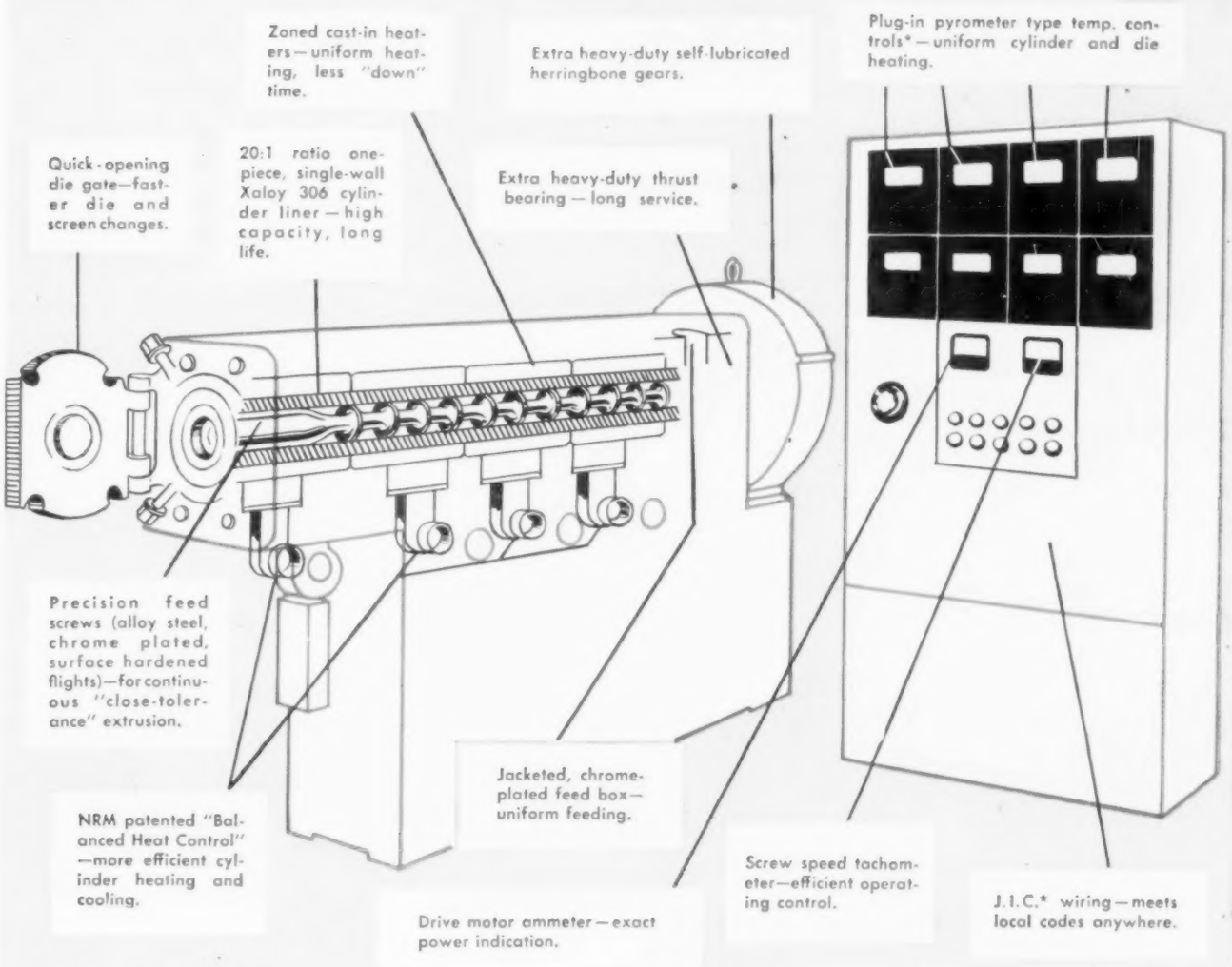
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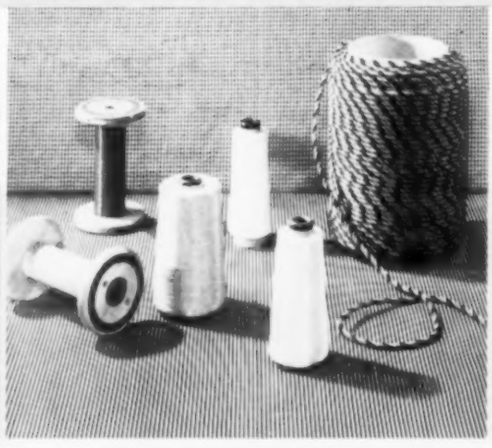

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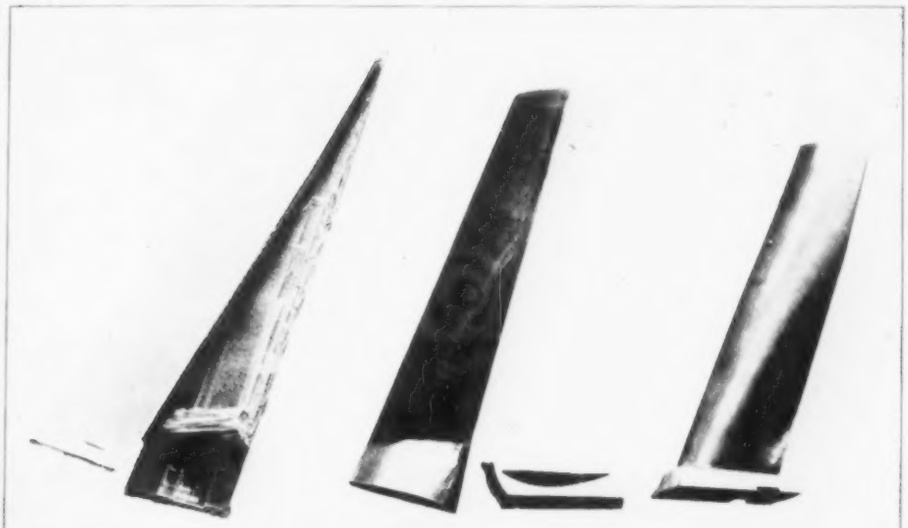


SEQUENCE OF MOLDING AND ASSEMBLY OF PLASTIC COMPRESSOR ROTOR BLADES

Plastic Rotor Blades for Turbojet Engines

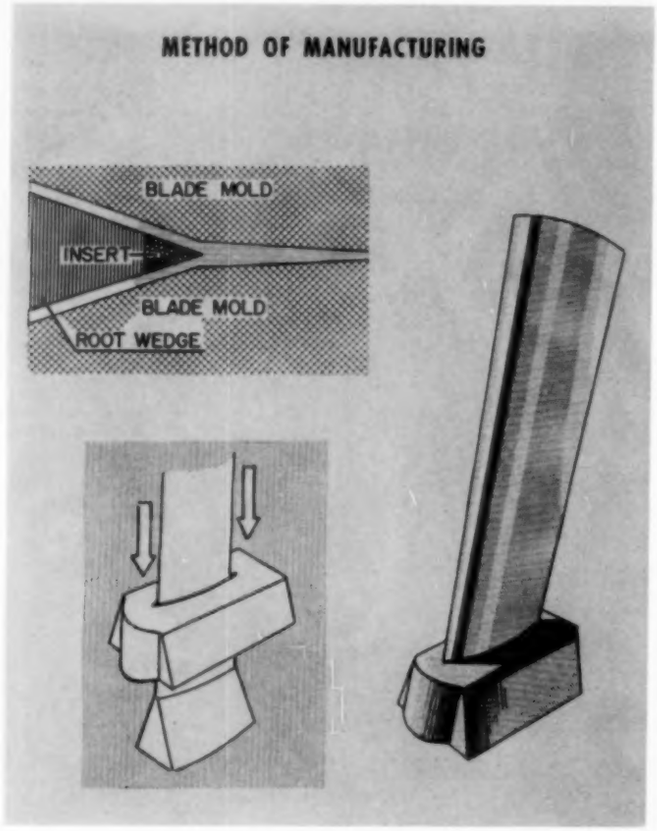
. . . the idea of using plastics in jet engines may seem absolutely incredible. Actually it is a sound and practical possibility . . .

John Kulp
General Electric Co.
Cincinnati, Ohio

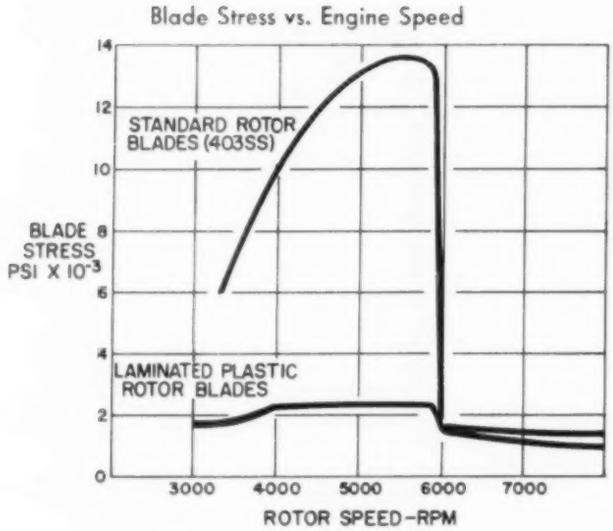
THE AIRCRAFT GAS TURBINE Division of the General Electric Company first gave serious consideration to the use of reinforced plastics for compressor blading in the early part of 1952. At that time, the J-47 engine was in large scale production and appeared to be the type of engine which would profit from the application of both plastic rotor and plastic stator blades. These profits would manifest themselves in the form of reductions in cost, weight, and critical materials. The replacement of stainless steel by plastics results in a first order weight reduction. A second order effect accrues from lower rim stresses in the rotor wheels, which in turn permits the use of either lighter metal wheels or radically different designs for compressor construction or both. The net gain here is in the increased payload of the aircraft. An economic survey based on specific production rates indicated a substantial cost reduction by using plastic blading. Critical materials reduction is difficult to estimate. There is little question, however, that in the event of an emergency, plastic blading in jet aircraft could save appreciable quantities of critical materials.

A rotor blade is simply an airfoil structure with a means of attaching it to a wheel. The blades are mounted

This paper was presented at the Thirteenth SPE Technical Conference.



Plastic Rotor Blade
for Turbojet Engine



on wheels and rotate at speeds ranging upwards to 22,000 rpm, depending on the particular engine being considered. The blades which we tested experienced a maximum speed of 8400 rpm. The function of the compressor blade is simply one of compressing air from one stage to the next until a specific pressure is established at the entrance to the combustion section. It is important that they perform this task in the most aerodynamically efficient manner possible—which appears to be another area in which plastic rotor blades might make a contribution.

In the J-47 engine compressor inlet temperatures are approximately 150°F; compressor exit temperatures are approximately 550°F. From a thermal stability point of view, therefore, it would seem reasonable to consider the use of glass-fabric-reinforced compressor rotor blades for application in engines of this type.

Its function and location might be more readily understood if the reader has a general understanding of the engine itself.

In the case of a jet engine, dry air is inhaled, compressed, its temperature further raised by burning fuel, then expanded through a turbine where sufficient energy is extracted to drive the compressor. The pressure after the turbine is greater than the intake pressure and by expanding the gas to atmospheric pressure, energy is made available for propulsion.

The gas is converted into kinetic energy by expanding it in a propelling nozzle. The thrust depends on the mass and velocity of the gas. For a given mass of air the more fuel burned the higher the temperature, the greater the pressure and the higher the velocity generated after expansion. This produces greater thrust.

Now, the blade in question is located in the compressor and on the periphery of the compressor rotor wheel. The wheels rotate at speeds up to 22,000 rpm depending on the engine being considered. The stresses imposed on the blade are primarily a function of tip diameter and rotating speed. Bending stresses are also imposed by the gasses "loading" the concave surface of the blade.

Fabrication Techniques

The ultimate usefulness of plastic rotor blades depends upon how well they are made. As the first step we surveyed the field and finally selected CTL-91LD as the best high temperature resin available at the time. We then selected the Cincinnati Testing and Research Laboratories to fabricate the blades. Knowledge of the characteristics of 91-LD and experience and enthusiasm for work in the field of plastics blading made them a natural selection for this project.

The over-all mechanical properties desired in the blades were obtained by the judicious combination of three types of glass fabric: 181 and 112 cloths, both basically orthotropic, and 143 cloth, which is basically undirectional.

The first step in the process was to impregnate the glass fabric with 91-LD resin. The impregnated fabric was then cut to predetermined shapes and stacked together so

that the smallest rectangles form the center of the blade and provide for the necessary changes in cross sectional dimensions along the length of the airfoil. The layup consisted of a combination of 181 and 143 fabrics internally with 112 fabric (a very fine weave) used for the skin of the airfoil. The base of the blade, where it flares to the dovetail, was formed by inserting a small bundle of impregnated rovings in the center and close to the base of the layup.

The layup was then placed in hardened, matched steel dies and was compression molded at approximately 200 psi and at 250 to 300 F. Upon removal from the mold, the base was trimmed and the tip cut to the appropriate length. The aluminum dovetail was then fitted onto the blade and held in place with an appropriate adhesive.

Preparation for Engine Testing

The vehicle used for our test was a J-47-E engine. The rotor of this engine was built up with plastic blades in stages two through six with the exception of two standard 403 stainless steel blades in stage two which were used as stress level references. A total of 260 blades were employed in the test.

Instrumentation of the rotor consisted of CB-7 type strain gages on two plastic and two steel blades in stage two, two plastic blades in stage four, and two plastic blades in stage six. The strain gages were bonded to the convex surface of the blades at the thickest section of the airfoil with the strain grid center 5/8 inches from the base of the airfoil. A thirteen-ring collector assembly was used to remove the strain gage signal from the rotor to the measuring and recording equipment. Cathode ray oscilloscopes were used to monitor the strain signals throughout the test period. The strain signals were recorded on a seven-channel magnetic tape recorder. Six strain gage signals were recorded simultaneously, and the remaining channel was used for oral identification of recorded signals during the running of the test.

Test Procedure

Upon completion of the instrumentation and rotor build up, the assembly was dynamically balanced, accelerated to 8400 rpm for 3 minutes, and finally check balanced. The check revealed no unbalance resulting from the high speeding. The rotor was then installed in the test engine and sent to the cell.

The actual procedure employed was a standard Air Force endurance test. This consists of cycling the engine between idle and military speeds with intermittent runs at normal rated and 90% of rated speeds and various acceleration and deceleration exercises. Also embodied in the procedure are periodic throttle bursts (throttle from idle to military in 1 second). One full cycle requires 5 hours. Throughout the test a continual recording was made of fuel flow, exhaust gas temperatures, engine vibrations, and similar critical measurements.

Test Results

The prime result was that all plastic blades successfully completed 100 hours of endurance testing.

Details of the strain gage analysis would be neither interesting nor meaningful. Some of the outstanding results, however, are revealed in the graph on the opposite page. In this graph of blade stress versus engine speed, the rather remarkable difference in stress level for both plastic and steel blades is seen. The graph shows the comparison only for stage two. The picture for all other stages tested would certainly be comparable. As the figure shows, the maximum blade stress levels recorded were in the speed range below 5800 rpm. At approximately 5800 rpm, the stress level dropped rapidly to about 1.3 to 1.6 the peak values observed at lower speeds and remained at this level up to maximum speed.

There was no synchronous resonance observed for any of the normal modes of blade vibration in the operating speed range. This was anticipated, however, on the basis of bench vibration frequency data on these blades and lack of synchronous unit configuration stimuli in the frequency range of the blades.

Aside from the scrutiny given the blades during testing, we attempted to glean some facts regarding engine performance from the run even though the test was conducted primarily to establish the endurance characteristics of the blades. From the periodic reading of fuel and oil flow, turbine and compressor vibrations, tailpipe temperatures, and thrust, an approximate idea of engine performance was obtained. These data indicated that the performance of this engine was comparable to that of a conventional engine, i. e., one built up with conventional 403 stainless steel blades. This is particularly significant in view of some of the difficulties we had in building up the test engine. One striking result in performance was the time required to go from idle to military speed under throttle burst conditions. In the case of an engine with steel blades, the time required for this maneuver varies from 10 to 14 seconds; with the rotor built up with plastic blades, this time interval was reduced to 9 to 10 seconds with a very smooth acceleration.

A thorough visual inspection of the rotor blades upon completion of 100 hours endurance testing revealed no detrimental effects resulting from the test. The airfoil surfaces of the blades failed to show indication of erosion, and, of course, there was no corrosion.

Conclusions

As more thermally stable resins emerge from the laboratory, engines exhibiting higher compressor temperatures than those found in the J-47 may also be able to utilize reinforced plastic compressor blading. Indeed, if the plastics world ever hopes to see widespread application in jet engines, better resins must evolve. Solution of this problem is not the end, however. One other major problem exists that demands solution, and that is the matter of what might be called engineering inertia. Reliable data on all useful mechanical properties, at both room temperature and elevated temperatures, must be made available to design engineers before there can be much hope of overcoming the resistance met by these materials for such engineering end uses. We can feel some measure of confidence that such resistance will be overcome, for the successful engine test just described strongly suggests the feasibility of using glass fabric reinforced plastic compressor blades in jet engines.

The author wishes to recognize and thank Mr. George LaPerche for his excellent work in preparing the rotor for test and in analyzing the strain gage data collected. Without his help, the overall test result would have been substantially less significant.

★ ★

Problems in the . . .

Selection of Extruder Screws

Robert Sackett
Monsanto Chemical Co., Plastics Division
Springfield, Massachusetts

PEOPLE OFTEN SPEAK of optimum screw design. The development of optimum screw design is quite expensive and in its truer sense would require a special screw for each specific die. Consequently one must be satisfied in most cases with screws somewhat short of optimum. This is not to imply that screw design is not critical, nor that it is not important. The literature is full of references that point out the need for designing a screw for a specific application or specific material. It is very seldom that a screw is actually suitable for several different types of plastic.

Because of the importance that proper screw design plays in the financial success of an extrusion operation, it is difficult to understand why so little attention has been paid to the design of extruder screws in view of the present level of development of extrusion knowhow. It is not uncommon to visit a concern experiencing extrusion difficulty and find out that they know little about their screw other than the compression ratio and whether or not it has a torpedo.

Screw Variables

In this paper, no attempt will be made to offer optimum screw designs. What is probably more important is to have some understanding of what the important screw variables are and just how they effect the quality and output of a given screw. Then it is important to understand the effect of those variables, over which the operator has control, on the operating characteristics of the screw. With a thorough grasp of this knowhow, one is in a position to get the most out of the existing screws and will have a better idea of what improvements can be made in screw design to best suit his particular needs.

Much has been done in recent years on theoretical formulae that are useful in screw design work. This work has been extremely helpful to the industry as a whole in providing an understanding of what occurs in the extruder. The applications of the equations themselves are not simple and their proper use requires a very complete understanding of the entire extrusion process. The equations deal essentially with output based on the geometry of the screw and the flow properties of the plastic. No factor is provided for quality. Because of the importance quality plays in any operation, the actual design of a production screw requires considerable practical background to supplement the theoretical calculations.

Basic Extruder

To the practical extrusion engineer, and by practical is meant the engineer responsible for production, the important thing to derive from the theoretical work that has been done is how this explains many of the things which he has previously observed but never been able to quite understand or analyze. Before being concerned with specific problems of screw design, it should first be determined what basic type of extruder will be used. Normally, this would involve a decision as to whether a single stage or two-stage extruder will be used. It may also include a decision as to whether or not a single or twin screw extruder should be used. Twin screw extrusion is a subject about which much has been written recently. No attempt will be made to cover this highly controversial subject; the paper will be limited to single screw extrusion.

The two-stage or devolatilizing screw is not new to the raw material producer. Although it has been available for some years, its general use by the fabrication industry is relatively new. Figure 1 is a sketch of the basic principle involved in the two-stage extruder. In reality, it is actually one extruder feeding a second extruder, but both are driven from the same motor along a common drive shaft. The first stage performs the solids conveying and the plasticizing or melting of the plastic.

The plasticmelt is then metered to an open section where the pressure is essentially reduced to zero. At this point, any volatiles such as moisture, air, or unpolymerized ingredients are permitted to flash off, or in some cases, vacuum is applied. Careful balancing of the

This paper was presented at the Thirteenth SPE Technical Conference.

Figure 1. (Top) Typical two-stage screw, and (below) a vented screw.

two stages must be done in order to prevent material from coming out of the vent. The volume of the vent section must be considerably greater than the actual volume of plastic being fed into it. This permits the greatest surface exposure and maximum venting action. The second stage brings the stock up to the desired temperature and develops sufficient pressure to fulfill die requirements.

The greatest success for vented extruders has been in the field of cellulosics and more recently in the acrylic field. Probably one of the most promising applications is the possible use of vented extrusion in eliminating porosity in large cross-section vinyl extrusions. There are those who claim that many types of extrusion now being done on single stage machines can better be done on vented machines.

It is my opinion that the two-stage extruder should not be looked upon as merely an extruder capable of performing a drying operation. Where simple hopper drying is sufficient, there is little reason to justify the use of two-stage extruders. Where a difficult devolatilizing problem exists, its close examination is warranted. Vented extruders are normally made in the range of 24-1 L/D in order to compensate for the loss in pressure and forwarding capacity of the devolatilizing section. Extruders have been built with 30-1 L/D.

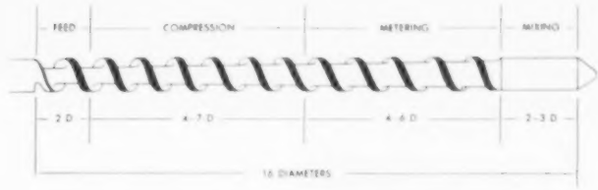
The Single Screw Extruder

So much for the various basic types of extruders. Now, lets look at some of the important factors affecting the output and quality of a single screw extruder. For convenience, the screw is normally divided into four major sections, the feed, compression, metering, and mixing sections. Figure 2 is a sketch showing the main sections of the screw and important screw dimensions.

The feed section of an extruder is essentially a screw conveyor. The material to be processed is usually in the form of solid granules, a powder, or a relatively free flowing mixture of several ingredients. It is fed by gravity flow into the screw channel. The channel is normally full and flow occurs because of the difference of coefficient of friction between the material and the screw and the material and barrel surfaces respectively. For maximum conveying action, it is desirable to have a minimum of slippage at the wall and a maximum amount of slippage at the screw surface. For this reason, highly polished or slightly matte finished screws are desirable.

Normally, the barrel temperature is maintained higher than the screw temperature and the material tends to adhere to the barrel. As it becomes softened it

Figure 2. A constant-pitch, variable root diameter screw.



will slip on the cooler screw surface. If the screw is allowed to become overheated, then the material will stick to it and merely ride around with the screw with little forward motion. Screws are generally equipped with cooling water to control this condition. In the conventional extruder, the hopper opening will have a length of about 1 to 2 diameters.

In order to insure proper feeding, the feed section of the screw is made approximately 2 diameters in length. Flights in this section should be made relatively deep in comparison to the rest of the screw, an obvious limit to the depth of the feed flight is the necessity of having sufficient strength in the root diameter to meet the power requirements.

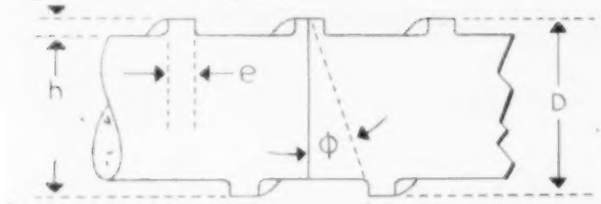
The purpose of the compression section is to densify the feed and to eliminate air from between the particles as they become heated. In a sense, it is also a transition zone between the deep flighted feed section and the more shallow metering or pressure developing section. The plastic material in the compression region is a mixture of solid granules, partially plasticized material, and completely plasticized material.

The Metering Section

The term metering section refers to that section of the screw where the plastic is a melt. It is normally of constant geometry in order to permit conditions to come to a state of equilibrium as far as temperature and pressure is concerned. The length of the metering section will vary from $\frac{1}{4}$ to $\frac{1}{3}$ the length of the screw, but it is usually determined by previous experience with similar materials. The metering section is the key portion of the screw, and in most cases, determines the actual operating characteristics of the screw. As we proceed in this paper, we will show how changes in the geometry in this section affect the output, pressure developing capacity, and quality of the extrudate.

All extruder screws are expected to do a certain amount of mixing. However, where special mixing problems are involved, it is usually desirable to add a separate mixing section to the extruder screw. This can be in the form of smooth or helically fluted torpedo, or some other type of mechanical mixing device. Normally these mixing devices will have little forwarding or pressure developing capacities and consequently should be avoided whenever possible. Some people favor the use of some type of mixing device to assist the metering section in eliminating surging, and insuring uniform temperature distribution. Although with certain screw designs this technique may be successful, a more desirable procedure would be to make modifications to the metering section. This latter technique should result in improved quality.

Figure 3. Screw Variables.



TT = 3.14
D = Diameter
t = Pitch = 1.1 D Tan. O
h = Flight Depth
e = Width of Flight Land
δ = Screw Clearance
lx = Distance Between Pressure Points
△P = Pressure Difference
ν = Viscosity
N = Revolutions
f = δ/h
ϕ = Helix Angle

Figure 4. Two ways of getting desired compression ratio: at top, constant pitch, variable root diameter; at bottom, constant diameter and variable pitch.

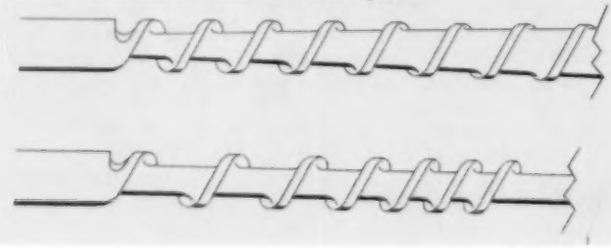
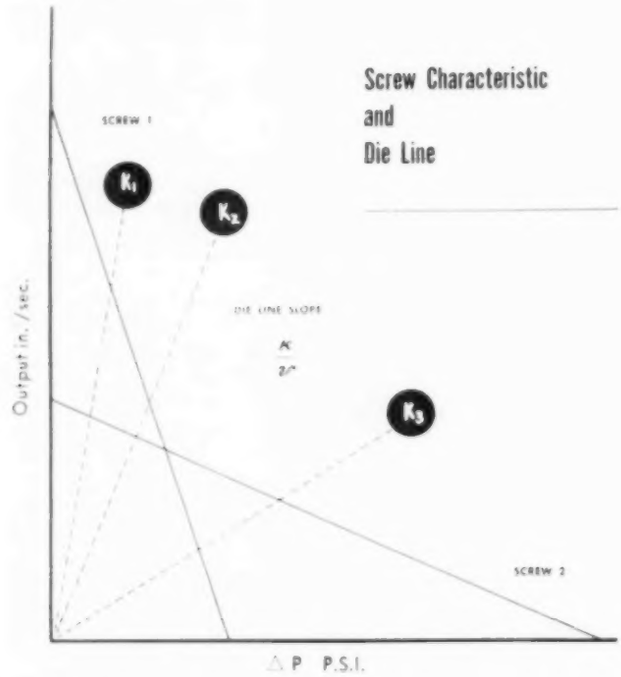


Figure 5.



Screw Dimensions

Shown in Figure 3 are the screw dimensions which are of primary importance with respect to the operating characteristics of a screw:

Length of screw
Metering flight depth
Screw clearance
Helix angle
Screw diameter

In previous years, compression ratio was considered a convenient means of classifying extruder screws. Because appreciable differences were observed between screws of different compression ratios, this method of classification has been regarded adequate by some. In many cases, screws with the same compression ratio will perform differently. This indicates that there is something other than compression ratio accounting for the different performance of various screws.

The importance assigned to compression ratio is, in many cases, exaggerated and permitted to overshadow other factors of screw design which are more important to quality and output. In a great number of cases, flight depth, pitch, and length of the metering section are all considerably more important, yet they are not as thoroughly considered as changes in compression ratio.

Because of the fact that the feed section of the screw is normally over designed, it is a rare case that the compression ratio is required to compensate for the actual change in bulk which occurs when the material moves through the extruder. The main function of the compression ratio is in preventing air from being occluded and carried forward. The compression ratio is of secondary importance in forming a wedge of material against the barrel wall to improve heat transfer. This wedge will also result in increased frictional forces against the barrel wall aiding both in the mechanical development of heat and in the conveying action of the extruder. It has been generally concluded that differences in output and quality that occur with screws of different compression ratio are the result of differences in the screw geometry that go to make up the compression ratio and not the compression ratio itself.

Compression Ratio

There are essentially two common means of obtaining compression ratio, and these are shown in Figure 4. One method is to vary the pitch and maintain the root diameter constant. The other method is to maintain the pitch constant and vary the root diameter. In some instances, compression ratio is obtained by both procedures.

In most newer screws, the compression ratio is obtained by maintaining the pitch constant and varying the root diameter. It is our opinion that the constant pitch method of obtaining the compression ratio is preferred when all factors are considered. The general trend in the industry appears to be in this direction also. It cannot be said that all constant pitch screws will outperform all variable pitch screws. We feel, however, that if optimum designs of each were compared, that the constant pitch screw would show better overall performance. Screws of both types and combinations of both are satisfactorily performing in field service. Inasmuch as optimum design is somewhat difficult to obtain, in many cases there can very well be instances where variable pitch screws are working to better satisfaction than other immediately available constant pitch screws.

Comparing the two types of screws from the theoretical standpoint, it is well to consider the following major factors:

Operating characteristics
Thermal effects
Mixing
End effects

Operating Characteristics

Normal requirements for an extruder are to deliver a maximum quantity of properly mixed and colloided material with a number of different dies. In other words, it is desirable to have a screw, in most cases, that is as versatile as is practical and one that will perform satisfactorily over wide operating conditions. Figure 5 shows a plot of the output of the extruder against the pressure at the die. This line is generally referred to as the screw characteristic line, as it represents the performance of a screw over a wide range of conditions. The screw characteristic line for a variable pitch screw will normally be steeper than that obtained by the constant pitch screw. This means that, as screens become clogged or as we go from dies with varying amounts of back pressure, the output will vary more on the steeper line or the variable pitch line. Were dies always operated with low back pressure then the steeper line would result in higher output. If desirable, it is relatively simple to built a constant pitch screw that would also give a steeper line, and this can be done by making the flight depth deeper. It is somewhat more difficult if not impossible to make a practical variable pitch screw with a flat line.

Thermal Control

To assure uniform production with respect to dimensions, surface and orientation, material must be delivered to the die at as uniform temperature as is possible. In addition, certain materials like vinyl cannot be subjected to high temperatures or degradation will occur.

Aside from the advantages of a shallow flight for mechanical heat development, a shallow channel is preferred for best thermal control because of the low thermal conductivity of plastics. In a constant pitch, screw compression ratio is obtained by reducing flight depth and consequently a relative shallow flight depth exists. In the solids flow section, the increasing root diameter acts as a wedge to force material against the barrel surface which in turn improves the heat transfer. The variable pitch screw has a constant root diameter and flight depth and the channel is normally deeper than the constant pitch screw. The rate of thermal conduction through a given body varies inversely as the square of its thickness. If in one case we have a flight depth of .1" (constant pitch) and the other 2" (variable pitch), then it will take about four times as long to heat the thicker piece. In practice, to partially compensate for this, we will normally increase cylinder temperatures or reduce RPM but this is not always desirable.

Mixing

The problem of mixing is controversial and a decision as to which type screw is normally preferred would probably depend on the type of mixing required. Where mixing is of major concern, it should be considered as a separate function and a suitable mixing device to do this should be provided.

There are primarily two types of mixing in the extruder to consider. One is an actual physical mixing of the ingredients as obtained in a blender, and the other a shearing type similar to that obtained on a paint mill. The physical type of mixing occurs to the greatest extent in deep flighted screws such as the variable pitch. The high shearing stress type of mixing occurs to the greatest extent in the shallower constant pitch screws.

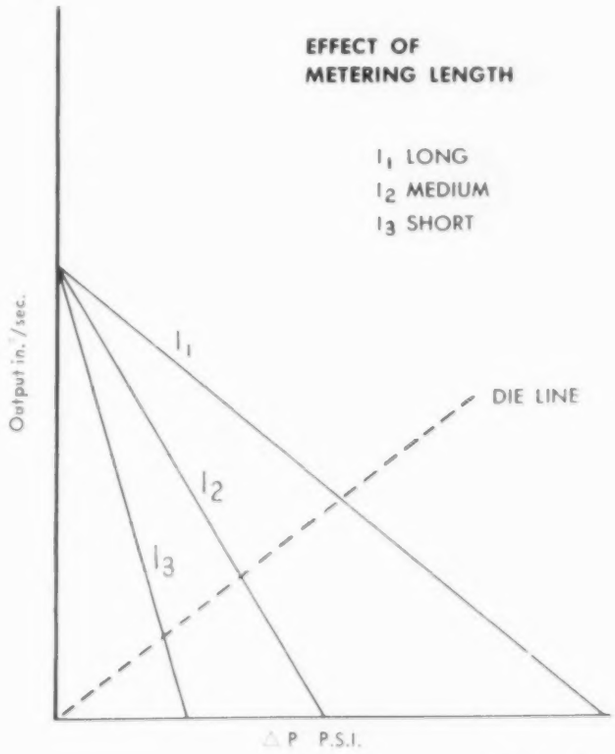
Which of these two types of mixing is the most important is difficult to say. Some of each is necessary in all cases and some of each type exists in both types of screws. One might liken the two types of mixing to the following example. If an agitator is placed in a container of water to which has been added a number of different colored styrene pellets, considerable physical mixing will occur but each pellet will remain completely intact. Now, if those same pellets are placed on a mill roll, they will be subjected to considerable shearing stress and each particle will be broken down and permit more effective physical mixing with other pellets. In the case of gels of polyethylene, fish eye in vinyl, possibly uncolloided particles of rubber in styrene alloys, and colorants in any thermoplastic, the shearing type of mixing is undoubtedly important.

The above reasons in themselves probably are not sufficient reason for choosing one screw over the other, but are additional factors in favor of the constant pitch screws.

End Effects

When the ratio of flight depth to flight width is more than 1-10, the effect of the flights on the flow of material along the helical channel is significant. A ratio of more than 1-10 will normally be encountered in variable pitch screws as the angle decreases (flight width decreases) and the flight depth is held constant. With this type screw, ratios as high as 1-4 are not uncommon.

Figure 6.



The primary importance of end effects is its bearing on material hold-up. The deeper the flights with respect to the width, the greater is the hold-up in the corners of the flights. As the flight width narrows, the corners come closer together and end effects become of greater importance. In the case of some plastics, this may not be too important, but it might be in the case of those materials that are subject to thermal degradation.

Let's look now at some of the major variables of screw design and some of the operating variables and see the relationship they have on output.

It has been previously mentioned with reference to Figure 5 the effect of flight depth on the screw characteristic line. The importance of this becomes more apparent when considered in conjunction with the die characteristic line. The die line is the line drawn through the operating point and the origin. Shown in Figure 5 is both the die line and the screw line. These are just hypothetical cases but they show that with dies that offer high back pressure, maximum outputs can be actually obtained by the shallower flighted screw. Those dies that offer little die resistance will give maximum output with the deeper flighted screws. In other words, output must be sacrificed to obtain the pressure developing capacity of the shallow flighted screws. From a diagram of this nature, the inter-relationship of the die and screw lines is seen. It is apparent that one should be careful about making generalities about the screw without reference to the die.

Longer Extruders

There has been considerable talk in recent years over the advantages of longer extruders. Figure 6 illustrates the effect of longer metering sections in a pressure-output diagram. It can be seen that at high die resistance, the increase in output is appreciable and the effect falls off as die pressure goes down. The longer barrel has the further advantage of permitting a longer dwell time, and subsequently more uniform temperature. In materials where thermal degradation is a problem the longer barrel permits the use of lower barrel heats and reduces the tendency for localized hot spots. In those plastics where a serious mixing problem exists, of the type capable of being handled by an extruder, the long barrel is of assistance as it exposes the plastic to the shearing action for a longer period of time. This is especially true in vinyl dry blend extrusion where, in short barrel extruders, the material is not in the melt form possibly until the last flight. Under these circumstances, little time is available for mechanical working while the material is a plastic melt.

In polyethylene, the advantage of long barrels is primarily as a means of increasing output and affording better temperature uniformity. The gel marks present in polyethylene are such that the shear rates encountered in the extruder are not normally high enough to eliminate them.

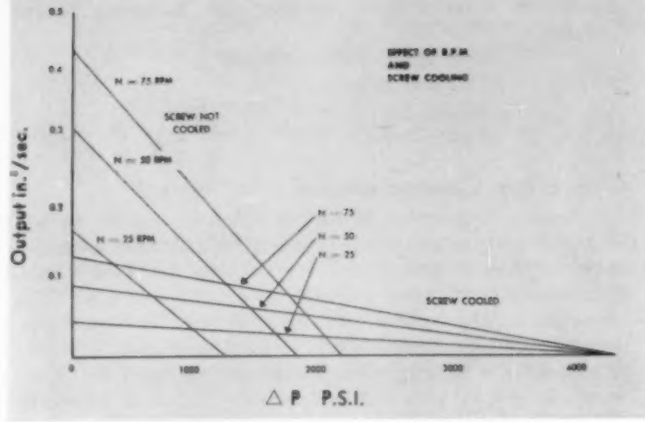
Major Variables

Three major variables that the extruder operator has at his disposal are:

Screw speed
Screw cooling
Screens

The effect of these variables on operating conditions can be shown quite effectively on an output-pressure plot. As shown in Figure 7, screw speed has a major effect on the output and results in moving the whole screw characteristic line upwards. In many instances, the limiting case is the power available or drive limitations of the equipment itself. With some screw designs, high RPM's reduce "inventory time" or the length of time the material is in the extruder to the point where insufficient compounding occurs. This can result in poor extrusion due to non-uniform temperature or poor working of the plastic.

Figure 7.



Also shown in Figure 7 is the effect of screw cooling on the screw characteristic line. In some cases, screw cooling can actually result in higher output, but generally it will result in reduced output. Essentially, screw cooling chills the material close to the root diameter and increases viscosity to the point where a shallower effective flight remains. As such, a water-cooled screw behaves as a shallower flighted screw. Increased output will be realized where pressure development is the limiting factor. The application of heat to a screw will generally increase the output of the screw but in many cases results in a sacrifice in quality.

Use of Screen Packs

Screen packs are a convenient means of increasing die resistance; as such they reduce output but at the same time quality generally improves. With the increase in resistance, material remains in the extruder longer and consequently is subjected to greater mechanical working. Where optimum screw design is involved, there is little need for large screen packs, and the only function of the screen is in removing contamination.

It should be evident from an understanding of the factors presented that it is important to have more than a casual knowledge of screw geometry. Knowing screw geometry and a few simple principles as those emphasized in this paper, permits one to intelligently analyze extrusion problems and to select screws, or better establish conditions suitable for the particular application in question.

A well recognized problem within the industry is the problem that the extrusion converter faces in selecting a screw design for a particular job. There is little agreement among machine manufacturers and material manufacturers as to what a proper screw design consists of. Anyone thoroughly familiar with the many complexities of the entire extrusion process, should not be alarmed by a condition such as this. It does make the problem of proper screw selection somewhat more complicated, and certainly points up the need for the progressive extrusion converter to be thoroughly familiar with the fundamentals of screw design in order that he may properly evaluate the various recommendations made to him. ★★

DANGER

in the Reinforced Plastics Industry

Roy C. Berg
Luun Laminates, Inc.
Huntington Station, New York

MANY MACHINES and tools used in the reinforced plastics industry are equipped with adequate guards when they are shipped by the manufacturer. These guards may be removed or they may disappear when the equipment is transferred from one owner to another. Often times, machines are fabricated on the premises to serve some special purpose with all thought given to performance, none to safety.

Makeshift guards give a false sense of security. Machines should have safeguards built into them as standard equipment at the point of manufacture. It is far less expensive to have built-in guards than attempt to build them afterward.

Limitations of space make it impossible to describe all the safety devices built onto individual machines and tools. Management, supervisors and safety men should know what these safety devices are. On new equipment the manufacturer's operating manual should be consulted. Once the proper safety devices are in place, it is up to management to insist that machines are not operated without these safeguards.

Conditions may often develop in the industry which call for modification of standard equipment. Before equipment is put into service, proper safeguarding should be installed.

Where it is found necessary to design and construct safeguards, these guards should have the following qualifications:

1. Sturdiness and durability: sheet metal, heavy wire mesh, transparent plastic, structural steel and pipe are preferable to wood.
2. Conformity to local and state specifications: American Standard Association standards are considered minimum requirements. Assistance in designing and installing safeguards for specific operation may be obtained from insurance engineers, state factory inspectors or local safety council.
3. Provision for convenient and safe access for lubrication, inspection adjustment and repairs.
4. Construction should be such that their use will depend as little as possible on the human element.
5. Avoidance of being hazards in themselves (sharp edges, abrasive splintered surfaces, or obscuring of vision).
6. Maximum protection without interfering with efficient operation of machine or tool. Points of operation such as revolving or reciprocating knives, cutters and saws should be enclosed so that operator cannot make contact with moving parts. Saws and grinders should be equipped with shields to protect against flying particles.

Further information on devices for specific machines and tools is contained in the following paragraphs:

Use of Color

Color can be utilized to emphasize danger points of machinery and working areas, thus supplementing mechanical guarding. Contrasting colors of proper reflecting values are the most suitable for machines. The critical parts should stand out in contrasting colors.

The A. S. A. Safety Color Code for marking physical hazards and the identification of certain equipment recommends that special colors be used to highlight electrical equipment, fire fighting equipment and hazardous parts of machines such as exposed edges of cutting equipment.

Control (Personal Factors)

There is no complete substitute for a well-trained, safety-concious man. However, guards and safety devices, when installed and used as they should be, offer protection to the operator and others in the vicinity.

Guards are of no value if the operator attempts to run his equipment without them. Safety devices not properly maintained may fail at critical moments. Control over the machine is dependent upon those who man it.

Control may be developed through training and an awareness and correction of unsafe practices at the source. The Supervisor has a stake in the safety of his men, because accidents are interruptions and interruptions result in higher cost and lowered production. The Supervisor who trains himself to notice the activities of his employees on the job, and to spot whether or not these activities are being performed safely, will be more likely to have injury-free operation.

This paper was presented at the 12th SPI Reinforced Plastics Division meeting.

Every employee's training should include detailed instruction on safe practices and he should be closely supervised to assure obedience to instructions.

Employees should be educated to the dangers of unauthorized operation of machines. Management should have a strictly enforced policy that only trained and authorized persons be allowed to adjust and operate equipment.

Material Preparation

Electric cloth-cutting machines, straight knife and circular blade: The electric cloth-cutting machine is indispensable for cutting large amounts of dry material, a great aid to production. However, the operator must be taught to respect the extremely sharp blades and be thoroughly trained in its correct use. The following precautions should be observed:

1. Always have blade guards in place.
2. Hold material from the side rather than from the front of machine.
3. Use weights to hold material whenever possible instead of using the hands.
4. Power cable should be hung from overhead pulleys so as not to interfere with operator.
5. Don't attempt to remove particles from vicinity of blade while machine is running. Stop machine, then clean blade.
6. Do not attempt to sharpen blade by hand. Use automatic sharpener provided on machine.
7. Do not attempt to cut larger quantity of material than machine can safely handle. Cutting difficulties can lead toward accidents due to awkward handling and excessive pressure.
8. Keep machine clean, well serviced, running smoothly, and blades sharp for safe, efficient operations.

Razor Knives: The most suitable tool for cutting cloth and mat, dry or impregnated, is a knife consisting of a sturdy handle and changeable blades, very similar to a single-edge safety razor blade. To cut material efficiently a very sharp tool is necessary. Common sense in its use can prevent many cuts. If possible, they should be sheathed when not in use. Handles should be kept clean to prevent slipping while being used.

Weights and bars: Weights, usually lead up to 5 lbs., are used to hold ends of cloth and mat down while unrolling material; care should be exercised to keep weights away from the edges of tables to prevent their falling on employee's feet. When not in use, weights should be properly stored on shelf well below eye level in such a manner that they cannot be dislodged and fall down.

Bars, usually 1" x ¼" H.R. steel used as straight edges must be handled and stored in much the same manner to prevent similar accidents.

Impregnating machine: Gears, belts and pulley used to actuate a roller impregnator should be properly guarded. Operator's clothing should be free of loose ends with no draw strings, neckties or sleeves which might catch in machinery; aprons worn by operators should be snug fitting and secured lightly so that they can be quickly torn from the body if caught in the machine.

Resin impregnation of cloth is an untidy operation and good housekeeping should prevail at all times. The machines and surrounding area should be cleaned thoroughly after each usage. A sand box built around the base of the machine is one way to prevent excessive spillage of resin from spreading around the floor and preventing serious hazard of slipping.

Proper storage of impregnated cloth until its usage is essential. Here again excess resin must be prevented from collecting on floor of area. Wrapping rolls of impregnated cloth in plastic sheeting or wrapping paper prevents contaminating of outer layers of roll and prevents resin from dripping to shelves and floor.

Mixing machines: When mixing resins, it is best to use air actuated or explosion-proof electric power mixers, mixer to be firmly secured to edge of drum or mixing stand. Vessel containing fluid being mixed should be firmly secured so that vibration does not cause it to shift, thus either dumping or permitting mixing blades to come into contact with sides of the vessel.

Cutting Table and Cloth Holder: A large flat table, approximately 8' x 16', slightly lower than conventional height and covered with a light gage metal is used for cutting dry materials, a large four wheeled rack guided by tracks on each side of the table is used for holding rolls of cloth and mat. Rolling back and forth permits layer upon layer of material to be placed on cutting table. A small hoist and sling placed at end of table permits easy safe loading of material onto rack, eliminating back injuries caused by heavy lifting.

Molding

Reinforced plastics low pressure molding is, by and large, hand work. The molder or fabricator is required to use many types of power and hand tools. Proper instructions as to their use is essential. He will be required to lift heavy pieces, work in arduous positions, use materials of sticky, irritating and odorous nature, work from scaffolds above floor levels, inside of large molds; mix and catalyze quantities of resins to a high degree of accuracy, remove completed parts from molds, handle volatiles and many other functions too numerous to note.

Dermatitis and skin irritations can plague the molder if he does not keep clean. Rubber gloves, frequent hand washing and use of skin creams will eliminate these difficulties.

Power tools generally used are of polishing and buffing nature used in mold preparation and mixers used to prepare resin batches. Bonnets used for buffing should be firmly secured to machines; goggles should be worn when performing this operation. Care must be exercised with use of knives as described in previous paragraphs. Staging, scaffolding and floor areas must be kept clean to prevent falls. Proper methods of lifting must be taught to workers and use of gloves enforced when handling molded parts to prevent cuts from sharp edges.

Resins, styrenes and solvents are all volatile and smoking must never be permitted in molding areas. Smoking and matches lead the common causes of fire in industry, accounting for a great percentage of fires reported to the National Fire Protection Association. The main hazard lies in the continued burning of cigarettes after they are discarded.

Most plastics establishments have zones where smoking should be definitely prohibited, as in molding areas, painting and spray sections, trim areas where dust is heavy and any place where flammable solvents are being used, even in small quantities.

If smoking is to be permitted in the shop, the following procedure should be considered:

1. Study the hazards that smoking would create.
2. Check with insurance carriers and state laws for regulations governing smoking.
3. Confine smoking to areas set aside for this purpose.
4. Educate employees to the dangers of leaving matches or cigarettes without fully extinguishing them. Adequate material is available from the National Safety Council for this purpose.

(Please turn to Page 113)

CYANAMID

PLASTICS NEWSFRONT

EYE-LURING COLOR CAPS BEST-SELLING PACKAGES

To compete for attention on crowded toiletry counters and shelves today, many best-selling products add a cap of colorful BEETLE® Urea Molding Compound. The beauty of color—any color—is permanently molded in. Closures of BEETLE Plastic are practical, too: they resist alcohol, acetone and other solvents, resist staining, and don't have an electrostatic affinity for dust, so stay clean longer on shelves.

NEW PIPE JACKET STOPS UNDERGROUND CORROSION

Strong jackets of spirally wrapped glass cloth and LAMINAC® Polyester Resin combat corrosion in new prefabricated insulated pipe conduit for underground steam and hot-water systems. Developed by Temploc, Inc., Baldwin Park, Calif., the protective two-ply shell is much lighter, less costly and more corrosion resistant than conventional steel or tar-protected conduit. Insulation is sealed and vapor-proofed at the ends by bonding the cloth-resin shell directly to the bare pipe. Field joints of insulation, cloth and resin are easily applied at the site.

IMPROVED HOUSING FOR NEW pH METERS

To make the housings for Pocket model and ZER O MATIC* bench model pH meters (shown) unusually strong, impervious to chemicals and resistant to scratching and chipping, Beckman Instruments, Inc., molds them of CYMEL® 1077 Melamine Molding Compound. This tough, break-resistant plastic protects the delicate mechanism and also provides the attraction of color without the added production steps required in finishing metal. Color is part of the housing itself; there is no coating to wear or chip off . . . no metal to corrode. *Trademark Beckman Instruments, Inc.

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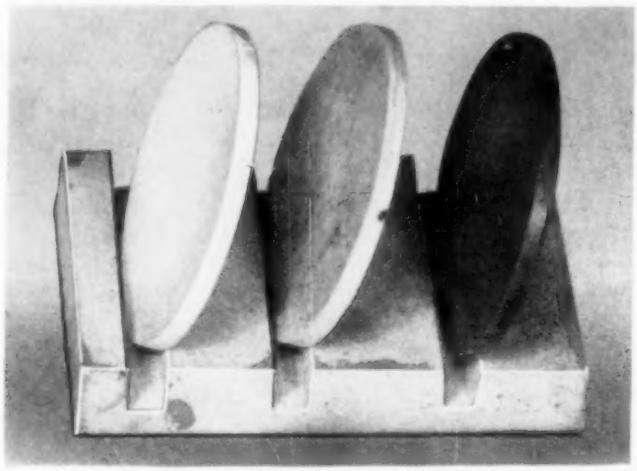
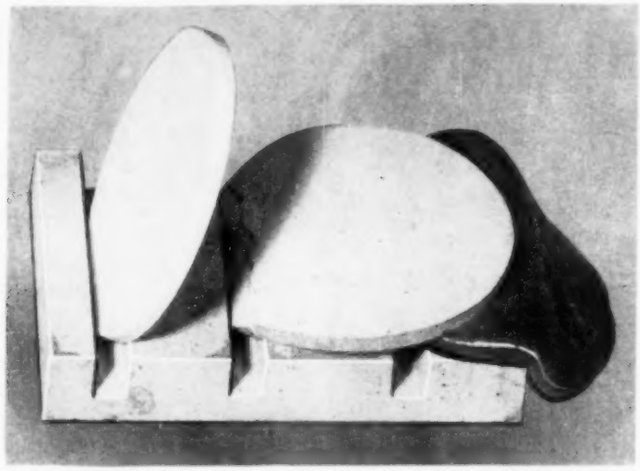
MATERIALS FOR TOMORROW



START OF TEMPERATURE TEST

SUPRAMICA* 560 ceramoplastic insulation (Left) is to be compared with SUPRAMICA* 555 ceramoplastic (Center) and MYCALEX 410* glass-bonded mica — the best available materials with comparable properties.



75 MINUTES AT 550° *PLUS* 15 MINUTES AT 650°C

SUPRAMICA 560 ceramoplastic still shows NO NOTICEABLE EFFECT — SUPRAMICA 555 has completely cracked through — MYCALEX 410 has foamed and collapsed.

SUPRAMICA* 560 ceramoplastic

INSULATION FOR CONTINUOUS OPERATION AT 500°C

LIGHTWEIGHT MATERIAL CAN BE MOLDED WITH FRAGILE INSERTS

SUPRAMICA 560 ceramoplastic will free your designs from many of the functional limitations imposed by conventional insulating materials. Manufactured exclusively by Mycalex Corporation of America, SUPRAMICA 560 has the electrical and physical properties to meet exacting high-temperature insulation specifications — **in applications where no other material can be used!**

Proof of this high temperature performance is shown by these unretouched photographs of an actual "slump" test (Above). The characteristics listed at the right demonstrate the versatility of SUPRAMICA 560 ceramoplastic.

Lighter in weight than any comparable material — specific gravity similar to that of aluminum or mineral-filled polyesters — SUPRAMICA 560 is the perfect insulation for relay bases, connectors, tube sockets and many other parts in high-temperature components.

MYCALEX CORPORATION OF AMERICA precision molds this revolutionary new material for your product needs. Send for complete information.

SPECIFICATIONS: SUPRAMICA 560 ceramoplastic

DISSIPATION FACTOR, 1 MEG.	0.003
DIELECTRIC CONSTANT, 1 MEG.	6.8
LOSS FACTOR, 1 MEG.	0.020
VOLUME RESTIVITY, OHM-CM	$10.^{14}$
SPECIFIC GRAVITY	2.8 (Comparable to Aluminum or Mineral-Filled Polyester)
SAFE OPERATING TEMP.	
CONTINUOUS	500°C
SHORT-TIME	600°C
WATER ABSORPTION	NIL
HARDNESS, ROCKWELL M	125
THERMAL EXPANSION	12.4×10^{-7} (Same as SAE 1010 Steel)
FLEXURAL STRENGTH, PSI	15,000
INSERTS	WILL ACCEPT ALL MOLDED-IN VARIETIES

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Drake Mold Eng. Co.
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119 S. Brainard Ave., LaGrange, Ill.

BROCK, RAYMOND L.
8039 Lake St., River Forest, Ill.

BRODNER, JOSEPH F., JR.
Damen Tool & Engineering Co.
2300 Elsten Ave., Chicago 14, Ill.

BROSIUS, ROBERT W.
7739 W. Hood Ave., Chicago 31, Ill.

BROTZ, ROMAN C.
Plastics Engineering Co.
1607 Geele Ave., Sheboygan, Wis.

BROWN, BENJAMIN F.
Hercules Powder Co.
332 S. Michigan Ave., Chicago 4, Ill.

BROWN, R. M.
Box 467, Pensacola, Fla.

BROWN, WILLIAM F.
Bakelite Co.
230 N. Michigan Ave., Chicago, Ill.

BRUMMER, MILTON L.
4935 Sherwin Ave., Skokie, Ill.

BRYAN, ALBERT
911 Busoe Hwy., Park Ridge, Ill.

BUCKMAN, CHARLES
7348 Ridge Ave., Chicago, Ill.

BURACK, ELMER H.
2206 W. Arthur Ave., Chicago 45, Ill.

BUSH, LEON D.
Leon D. Bush Co.
4248-50 W. Diversey Ave., Chicago 39, Ill.

BUZZEE, ROBERT D.
General Electric Co.
336 Weir St., Taunton, Mass.

BYRNE, JOHN R.
2645 N. Landon Dr., Melrose Park, Ill.

CADDELL, WILLIAM D.
Thomas A. Schutz Co., Inc.
8710 Ferris Ave., Morton Grove, Ill.

CALEF, JOHN F.
Automatic Electric Co.
1033 W. Van Buren St., Chicago 7, Ill.

CAPLAN, DONALD
Perfex Plastics, Inc.
2632 S. Dearborn St., Chicago 16, Ill.

CHADFIELD, ROBERT W.
Lake Region Products Co.
219 W. Illinois St., Chicago, Ill.

CHEELY, GEORGE W.
6938 W. George St., Chicago 34, Ill.

CHERWIN, MR. STANLEY G.
Han-Win Products, Inc.
726 S. Broadway, Aurora, Ill.

CHRISTENSEN, DELBERT L.
Flex-O-Glass, Inc.
1100 N. Cicero Ave., Chicago 51, Ill.

CLARKE, ROBERT C.
13 Northern Rd., Excelsior, Minn.

CLEAVENGER, THOMAS H.
7551 State Line St., Munster, Ind.

CONAWAY, PAUL
2704 Louis St., Franklin Park, Ill.

CONNORS, JAMES M.
Modern Plastics Co.
101 E. Ontario St., Chicago, Ill.

COOPER, WARREN F., JR.
Eastman Chemical Products, Inc.
922 London Guarantee & Accident Bldg.
360 N. Michigan Ave., Chicago 1, Ill.

CORBIN, JAMES R.
Firestone Plastics Co.
9-121 Merchandise Mart, Chicago, Ill.

COWAN, DAVID D.
417 Forest, Mt. Prospect, Ill.

CRANE, EDGAR
The Richardson Co.
27 & Lake St., Melrose Park, Ill.

CRAVER, JOSEPH N.
470 Shabbona Dr., Park Forest, Ill.

CROISANT, E. H.
Synthane Corp.
Morton Grove, Ill.

DAHL, KENNETH T.
Formold Plastics, Inc.
11955 Vincennes Ave., Blue Island, Ill.

DELI, FRANK D.
3121 Hawthorne Dr., Columbus, Ind.

DENSLOW, VICTOR A.
4141 Central Ave., Western Springs, Ill.

DEVOR, ELMER
General Electric Co.
2200 N. 22 St., Decatur, Ill.

DOOLITTLE, H. A.
American Gas Accumulator Co.
Stimsonite Plastics Div.
3445 N. Kimball, Chicago 18, Ill.

DORNIK, PETER, JR.
Apt 3-5, 4532 Broadway, Kansas City, Mo.

DOUGHTY, GEORGE G.
1504 Thornwood Dr., Downer's Grove, Ill.

DRINKWATER, THOMAS R.
8027 N. Long Ave., Skokie, Ill.

DUFFETT, N. B.
Bakelite Co.
230 N. Michigan, Chicago 1, Ill.

DUNCAN, DAVID L.
Minnesota Mining & Mfg. Co.
6850 So. Harlem Ave., Bedford Park, Ill.

DUNN, PETER J., JR.
Celanese Plastics Corp.
1514 Merchandise Mart, Chicago 54, Ill.

DURRA, JOSEPH B.
Ciba Company, Inc.
7535 Lincoln Ave., P.O. Box 216,
Skokie, Ill.

DUTZER, MICHAEL J.
Continental Can Co.
Millsplastic Research, 2930 N. Ashland
Chicago, Ill.

DVORAK, CHARLES J.
Franke St., Cary, Ill.

ECK, FRANKLIN E.
6807 W. 77 St., Overland Park, Kans.

ECKENBECK, EVERETT E., JR.
450 Winston La., Chicago Heights, Ill.

ECKENBECK, EVERETT E., SR.
1801 Chicago Rd., Chicago Heights, Ill.

EDELSTON, JOSEPH
1335 Astor St., Chicago, Ill.

EDGERTON, D. R.
610 Linden Ave., Wilmette, Ill.

EDLIS, STEFAN T.
General Die Mold Co.
648 N. Sacramento Blvd., Chicago, Ill.

EELLS, DONALD E.
1009 Hazel Ave., Deerfield, Ill.

ELLIS, JOHN D.
528 Green Valley Dr., Lombard, Ill.

ERICKSON, OSCAR E.
International Harvester Co.
5225 S. Western Blvd., Chicago 9, Ill.

ERLEY, WALTER
18360 Kedzie St., Homewood, Ill.

EVANS, LUTHER J.
Mayfair Molded Products Corp.
3700 N. Rose St., Franklin Park, Ill.

EXNER, WILLIAM E.
The Pyle National Co.
1334 N. Kostner, Chicago, Ill.

FABRY, RICHARD J.
The Richardson Co.
27th & Lake Sts., Melrose Park, Ill.

FALBERS, EDWARD F.
Joanna Western Mills Co.
Cormak & Jefferson Sts., Chicago 16, Ill.

FEID, ROBERT A.
B & T Plastic Finishing Co.
1124 Dodge Ave., Evanston, Ill.

FELSENTHAL, JAMES G.
G. Felsenthal & Sons, Inc.
3500 N. Kedzie, Chicago 18, Ill.

FERGUSON, JAMES
205 W. Wacker Dr., Chicago 6, Ill.

FIELD, CHARLES R.
438 Ridgeland Ave., Elmhurst, Ill.

FINA, PAUL E.
314 Herrick, Riverside, Ill.

FINE, F. L.
Rohm & Haas Co.
5750 W. Jarvis Ave.
Chicago 31 (Niles), Ill.

FINN, CARL S.
2415 Lawndale Ave., Rockford, Ill.

FISCHER, ANDREW J.
4554 Broadway, Chicago, Ill.

FISHMAN, LOUIS
Fishman Plastics Co.
442 W. Garfield Blvd., Chicago 9, Ill.

FLOREN, CARL E.
Mueller Co.
512 W. Cerro Gordo, Decatur, Ill.

FORD, PAUL B.
135 Bloomingbank Rd., Riverside, Ill.

FORST, ERNEST
Forst Die Mold Co.,
1769-1771 W. Sunnyside Ave.
Chicago 40, Ill.

FOSSE, JOHN S.
557 Fairview Ave., Glen Ellyn, Ill.

FOX, CYRIL B., JR.
Eastman Chemical Products, Inc.
922 London Guarantee & Accident Bldg.
360 N. Michigan Ave., Chicago 1, Ill.

FRANKENFELD, HUBERT F.
1456 Vernon Ave., Park Ridge, Ill.

FREEMAN, HANS
Creative Plastics Engineering
1912 N. Milwaukee Ave., Chicago 47, Ill.

FRIBERG, THEODORE
Globe-Imperial Corp.
2025 Kishwaukee, Rockford, Ill.

FURHOLMEN, ERICK
70 S. Grace St., Lombard, Ill.

GAINES, JAY H.
Catalin Corp. of America
221 N. La Salle St., Chicago, Ill.

GAMMEL, WALTER A., SR.
R-B-M Div. Essex Wire Corp.
131 Godfrey St., Logansport, Ind.

GEBHARD, HARRY W.
5129 W. Devon Ave., Chicago 30, Ill.

GIBSON, ARCH M.
5718 Kenwood Ave., Chicago 37, Ill.

GILKESON, EARL E.
165 E. Fillmore, Elmhurst, Ill.

GITS, JOSEPH A., JR.
1721 N. 77th St., Elmwood Park, Ill.

GOLDING, BRAGE
Purdue University
Dept. of Chemical & Metallurgical Eng.
Lafayette, Ind.

GOULKA, JAMES
1452 Bryn Maur, Chicago 40, Ill.

GRAY, ROBERT F.
408 Countryside Dr., Wheaton, Ill.

GREEN, WILLIAM E.
Owens-Illinois Glass Co.
St. Charles, Ill.

GRIER, HENRI B.
Cadillac Plastic Co.
727 W. Lake St., Chicago 6, Ill.

HADDEN, L. I.
Standard Mfg. Co.
1100 S. Central Park Ave., Chicago 24, Ill.

HALL, JAMES F., JR.
Box 413-A, R.R. #1, Wheaton, Ill.

HANNAFORD, VERN L.
The Dow Chemical Co.
Plastics Technical Service
Gales Ferry, Conn.

HART, WILLIAM A.
R.R. #1, Box 278, St. Charles, Ill.

HATFIELD, A. L.
B.F. Goodrich Chem. Co.
2116 Prudential Plaza, Chicago 1, Ill.

HECK, F. R.
908 Dawn Ave., Glen Ellyn, Ill.

HEENAN, S. A.
Stimsonite Div. of Esna
3445 N. Kimball Ave., Chicago, Ill.

HELLIWELL, S. STEWART
F. J. Stokes Machine Co.
3058 W. Peterson Ave., Chicago 45, Ill.

HENNING, JAMES L.
Plano Molding Co.
Plano, Ill.

HENRY, CHARLES C.
6705 Caldwell, Chicago 30, Ill.

HERBST, CLARENCE A.
Resinoid Engineering Corp.
3445 Howard St., Skokie, Ill.

HERRERA, DAVID E.
Greer Shop Training, Inc.
2230 S. Michigan Ave., Chicago 16, Ill.

HICKS, JOHN F.
668 S. Euclid Ave., Elmhurst, Ill.

HIDDING, WALTER E.
Blackhawk Molding Co., Inc.
Commercial Rd., Addison, Ill.

HILL, MERTON E.
Gossett & Hill Co.
7185 W. Bloomingdale Ave.
Chicago 35, Ill.

HINCHSLIFF, WILLIAM E.
Breyer Molding Co.
2536 W. Lake St., Chicago, Ill.

HLAVAV, CHARLES R.
Koppers Co., Inc., Chemical Div.
122 St. Michigan Ave., Chicago 3, Ill.

HOFFER, ROBERT A.
Foxval Molded Plastics Corp.
South Elgin, Ill.

HOFFMAN, L. EARL
Phillips Chemical Co.
111 S. York St., Elmhurst, Ill.

HOLLAND, CHARLES J.
Reed-Prentice Corp.
538 N. Western Ave., Chicago 18, Ill.

HOLLAND, CHRISTIAN V.
Continental Can Co.
Millsplastic Div.
2930 N. Ashland Ave., Chicago 13, Ill.

HOLLAND, MARVIN
225 N. Racine Ave., Chicago 7, Ill.

HOSEK, W. F.
2200 N. Mannheim Rd., Melrose Park, Ill.

HOWIE, JOHN L., JR.
Grigoleit Co.
740 E. North St., Decatur 5, Ill.

HUGHES, KENT H.
Hughes Plastics, Inc.
721 Pleasant St., St. Joseph, Mich.

HULTGREN, ARNOLD P.
American Molded Products
2727 W. Chicago Ave., Chicago 22, Ill.

CHICAGO

JARROW, STANLEY L.
Jarrow Products Co.
420 N. La Salle St., Chicago 10, Ill.

JARVIS, LACTANCE A.
Whirlpool-Seeger Corp.
300 Broad, St. Joseph, Mich.

JINDRICH, RALPH W.
The Richardson Co.
27 & Lake St., Melrose Park, Ill.

JOHN, FREDERICK W.
523 S. Craig Place, Lombard, Ill.

JOHNSON, ROY V.
Admiral Corp.
Monmouth Blvd., Galesburg, Ill.

JOHNSTON, JAMES E.
215 Kasper St., Arlington Heights, Ill.

JONES, JOHN R.
746 N. LaGrange Rd., LaGrange, Ill.

JORDAN, WALTER E.
Jordan Manufacturing Co.
1850 Miner St., Des Plaines, Ill.

KANN, ROBERT R.
Goodyear Tire & Rubber Co.
141 W. Ohio St., Chicago 10, Ill.

KAPPEL, HENRY C.
The Richardson Co.
Melrose Park, Ill.

KARELS, CHARLES
6457 N. Damen Ave., Chicago 45, Ill.

KARELS, THOMAS R.
B. & T. Plastic Finishing Co.
1124 Dodge Ave., Evanston, Ill.

KARNS, R. W.
28 Third Dr., South Shores, Decatur, Ill.

KASISCHKE, ROBERT S.
Hughes Plastics, Inc.
721 Pleasant St., St. Joseph, Mich.

KAZIMIER, HENRY A.
R.R. #3, Nashville, Ind.

KAZIMIER, J. C.
405 S. Kyle St., Box 163, Edinburg, Ind.

KEELEY, JOHN H.
Fiberfil, Inc.
Fox Farm Rd., Warsaw, Ind.

KELLY, WILLIAM
2240 W. 115th St., Chicago 43, Ill.

KEOWN, EARL R.
6643 Tower Circle Dr., Chicago 30, Ill.

KERSEG, W. F.
Ogden Dunes
203 Hillcrest Rd., Gary, Ind.

KEYSER, M. R.
Rohm & Haas Co.
5750 W. Jarvis Ave.,
Chicago 31 (Niles), Ill.

KIECKHEFER, HERBERT H.
Wheelco Instrument Div.
Barber Colman Co.
1300 Rock St., Rockford, Ill.

KINSEY, ROY W., JR.
2625 Elgin Rd., Evanston, Ill.

KLEIN, IRVING N.
H. Muehlstein & Co., Inc.
Plastics Division
4237 W. 42nd St., Chicago 32, Ill.

KLIMEK, STANLEY L.
3829 N. Spaulding, Chicago 18, Ill.

KNIGHT, RAYMOND L.
5310 W. Fletcher St., Chicago 41, Ill.

KNOCKE, WALTER A.
12502 S. 70 Ave., Palos Heights, Ill.

KOSOBUD, WILLIAM T.
Detroit Mold Engineering Co.
5901 W. Division St., Chicago 51, Ill.

KOSTUR, ROBERT E.
Comet Industries
9865 Franklin Ave., Franklin Park, Ill.

KRAKAU, A. LOUIE
Acme Scientific Co.
1450 W. Randolph St., Chicago 7, Ill.

KREHBIEL, J. H.
Molex Products Co.
9515 Southview Ave., Brookfield, Ill.

LABOUNTY, T. J.
Logo, Inc.
12933 S. Stony Island Ave., Chicago 33, Ill.

LANDON, GEORGE K., JR.
Continental Can Co., Inc.
2930 N. Ashland Ave., Chicago, Ill.

LANSEN, ROBERT A.
Monsanto Chemical Co.
Room 1524, 520 N. Michigan Ave.
Chicago 11, Ill.

LARSEN, LEONARD K.
202 W. Grand, Decatur, Ill.

LARSEN, WILHELM
Belton School of Tool Design
1059 N. Lawndale Ave., Chicago 51, Ill.

LASSER, ALLAN
Tower Oil Co.
300 W. Washington St., Chicago, Ill.

LAURITZEN, FREDERICK M.
Georges Mfg. Co.
9330 Franklin Ave., Franklin Park, Ill.

LAWRENCE, MELVILLE E.
740 Garland Pl., Des Plaines, Ill.

LECHNER, ALBERT M.
Carl A. Lechner Co.
1515 W. Howard St., Chicago 26, Ill.

LERNER, LOUIS L.
211 E. Delaware Pl., Chicago 11, Ill.

LESCHER, R. F.
7338 Palma Lane, Morton Grove, Ill.

LEVIN, CARL
Powdered Metal Products Corp. of America
9335 W. Belmont Ave., Franklin Park, Ill.

LEVINE, MARVIN S.
General American Transportation Corp.
135 S. LaSalle St., Chicago, Ill.

LIND, CARL J.
Lind Plastics Products, Inc.
6900 N. Central Park, Chicago 45, Ill.

LIND, TED N., JR.
Lind Plastic Products, Inc.
6900 N. Central Park, Chicago, Ill.

LINDAHL, FRED J.
Nixon Nitration Works
510 N. Dearborn, Chicago, Ill.

LISTER, JAMES M.
908 Morse Ave., Des Plaines, Ill.

LONGACRE, WALTER B.
706 N. 8th St., Manitowoc, Wis.

LOUER, JOHN C.
1617 S. 4th Ave., Maywood, Ill.

LOUIK, MARTIN
5064 A. W. Van Buren St., Chicago 44, Ill.

LOVGREN, ARTHUR
6726 Schreiber Ave., Chicago 31, Ill.

LUMBARD, EDWARD B.
Midwest Plastics Products
20 E. Jackson, Chicago 4, Ill.

MACK, JOHN
John Mack & Son
6227 N. Broadway, Chicago 40, Ill.

MACK, JOHN L., JR.
J. Mack Molded Products, Inc.
6227 N. Broadway, Chicago 40, Ill.

MARBERG, CARL M.
10917 S. Parnell St., Chicago 28, Ill.

MARCEAU, GERARD J.
133 S. Elmwood, Palatine, Ill.

MARSH, E. S.
Plax Corp.
1607 Howard St., Chicago 26, Ill.

MARVEL, JACKSON
Continental Can Co., Inc.
2930 N. Ashland St., Chicago 13, Ill.

MASSOPUST, C. F.
General American Transporation Corp.
Plastics Div., Room 2206
135 S. La Salle St., Chicago 90, Ill.

MC CORMICK, CLARENCE
6899 N. Hiawatha, Chicago 30, Ill.

MC CORMISH W. E.
533 S. Dearborn, Rm. 1109, Chicago 5, Ill.

MC MINN, ROLAND A.
Abbott Laboratories
1400 N. Sheridan Rd., North Chicago, Ill.

MEDL, ROBERT C., JR.
2533 Lawndale Ave., Evanston, Ill.

MELNICK, SIDNEY
6418 N. Bell Ave., Chicago, Ill.

MELTZER, MAURICE
1241 Lindenwood Dr., Winnetka, Ill.

MEYERS, DAVID
8509 N. Trumbull Ave., Skokie, Ill.

MILLER, DON R.
Don R. Miller, Designers
3543 Scott St., Franklin Park, Ill.

MILLER, NELS A.
946 Pleasant St., Oak Park, Ill.

MILLS, ELMER E.
Continental Can Co., Inc.
2930 N. Ashland Ave.,Chicago 13, Ill.

MILWARD, FRANK W.
Goodyear Tire & Rubber Co.
141 W. Ohio, Chicago 10, Ill.

MITTEL, WILLIAM A.
Amity Plastics Corp.
3735 Belmont Ave., Chicago 18, Ill.

MODJESKI, HOWARD F.
Logo, Inc.
13799 S. Ave. "O", Chicago 33, Ill.

MOLEN, FRANKLIN B.
Naugatuck Chemical Co.
4135 S. Pulaski Rd., Chicago 32, Ill.

MOORE, J. FRANKLIN
3920 N. Merrimac Ave., Chicago 34, Ill.

MOOY, RICHARD W.
225 N. Western St., Park Ridge, Ill.

MOSAK, JOHN B.
323 East St., Hobart, Ind.

MUIR, ANDREW C.
403½ 10th St., Fort Madison, Ia.

MULTER, ROBERT K.
Marbon Chemical Div.
Borg-Warner Corp.
1926 W. 10th Ave., Gary, Ind.

MUNRO, KENNETH E.
The Richardson Co.
27th & Lake Sts., Melrose Park, Ill.

MURRAY, CHARLES F.
Flick-Reedy Corp.
2040 N. Hawthorne Ave., Melrose Park, Ill.

NAGY, JULIUS J.
4011 N. Lowell, Chicago 41, Ill.

NELSON, A. WILLIAM
Rada Products Co.
2911 Carroll Ave., Chicago 12, Ill.

NELSON, JOHN F.
Monsanto Chemical Co.
520 N. Michigan Ave., Chicago 11, Ill.

NELSON, MELVEN V.
Autopoint Co.
1801 W. Foster Ave., Chicago 40, Ill.

NERING, THEODORE, JR.
Neering's Plastics
3982 Broadway, Gary, Ind.

NICHOLSON, WILLIAM
707 Grand Ave., Aurora, Ill.

NIEMI, OSCAR E.
5854 S. Rockwell, Chicago 29, Ill.

NOLAN, JOHN L.
2025 Wagner, Glenview, Ill.

NORTON, WILLIAM H.
Thermel, Inc.
9400 Robinson Rd., Franklin Park, Ill.

O'BRIEN, PHILIP
General American Transportation Corp.
300 W. 151st St., E. Chicago, Ind.

O'BRIEN, THOMAS W.
H. Kohnstamm & Co., Inc.
11 E. Illinois St., Chicago 11, Ill.

ORME, THOMAS R.
Bakelite Co.
230 N. Michigan Ave., Chicago 1, Ill.

PACKHEISER, Frank
Spencer Chemical Co.
First National Bank Bldg., Chicago 3, Ill.

PANNHAUSEN, JOHN
American Phenolic Corp.
1830 S. 54th Ave., Chicago, Ill.

PASOWICZ, WALTER E.
2342 N. Kenneth Ave., Chicago 39, Ill.

PEDERSEN, JOSEPH R.
2022 W. 82, Chicago 20, Ill.

PEDERSEN, VAUGHN
Amity Plastics Corp.
3735 Belmont Ave., Chicago 18, Ill.

PERZAN, HARRY J.
Dot-Lee Tool & Engineering Co.
2031 N. Parkside Ave., Chicago 39, Ill.

PETERSON, LLOYD A.
Stimsonite Division of E.S.N.A.
3445 N. Kimball Ave., Chicago 18, Ill.

PETERSON, MILTON O.
1743 Manheim Rd., Des Plaines, Ill.

PHILLIPS, RAYMOND F.
73 S. Westmore Ave., Lombard, Ill.

PIERCE, RUSSELL F.
2236 Park St., P.O. Box 1410
Terre Haute, Ind.

PILAT, THEODORE J.
415 W. Fairview, Arlington Heights, Ill.

PLOWRIGHT, ROBERT D.
847 N. Humphrey Ave., Oak Park, Ill.

PORTE, N. H.
General American Transportation Corp.
135 LaSalle St., Chicago, Ill.

PORTER, BENJAMIN T.
807 Greenwood, Glencoe, Ill.

PORTH, IRVING H.
1416 S. Vine Ave., Park Ridge, Ill.

POTTS, WILLIAM G.
National Rubber Machinery Co.
5875 N. Lincoln Ave., Chicago 45, Ill.

POUST, M. L.
350 Scott St., Glen Ellyn, Ill.

PRINDLE, DON G.
481 Fremont St., Elmhurst, Ill.

QUALLY, LLOYD E.
Temperature Equipment Corp.
816 N. Kostner, Chicago, Ill.

QUIESSER, ARTHUR J.
Queisser Brothers
110 E. Ninth St., Indianapolis 2, Ind.

RACKOW, JOHN L.
Eclipse Mfg. Co.
P.O. Box 338 (W), Lake Zurich, Ill.

RADEMACHER, GEORGE A.
Georges Manufacturing Co.
9330 W. Franklin Ave.,
Franklin Park, Ill.

RAICHE, ARTHUR J.
13 W. Ridge, Prospect Heights, Ill.

RAMSEY, A. L.
Box 37, Indian La., Ingleside, Ill.

RAMTHUN, BRUNO
2411 Brendenwood Rd., Rockford, Ill.

RANK, CHARLES
317 S. Greenwood Ave., Park Ridge, Ill.

RAPATA, GEORGE M.
Fastex Div., Illinois Tool Works
195 Algonquin Rd., Des Plaines, Ill.

RAYMOND, ROY D.
The Lakone Co.
500 Rathbone Ave., Aurora, Ill.

REINECKE, J. O.
Reinecke & Associates
155 E. Ohio St., Chicago 11, Ill.

REISING, VAL O.
Koppers Company, Inc.
122 S. Michigan, Chicago, Ill.

RICHARDS, T. E.
Midwest Molding & Mfg. Co.
Gurnee, Ill.

RICHTER, WINSTON H.
Monsanto Chemical Co.
520 N. Michigan Ave., Chicago 11, Ill.

ROACH, JAMES F.
Phillips Chemical Co., Plastics Sales DW.
111 S. York St., Elmhurst, Ill.

ROACH, RICHARD J., JR.
545 S. State Rd., Arlington Heights, Ill.

ROBBINS, KENNETH O.
Plastic Machine Corp.
1430 Mishawaka St., Elkhart, Ind.

ROBBINS, MAX B.
Hoosier Cardinal Corp.
601 W. Eichel St., Evansville, Ind.

ROGAN, EDWARD
Rogan Brothers
8025-8033 N. Monticello Ave., Skokie, Ill.

ROGAN, JULIAN J.
Rogan Bros.
8025-8033 N. Monticello Ave., Skokie, Ill.

ROSLEY, HOWARD A.
2107 Oak St., Northbrook, Ill.

ROWE, LEIF A.
Rowe Plastics & Die Casting Co.
955 W. Schubert Ave., Chicago 14, Ill.

RUEKBERG, H. S.
Continental Can Co., Inc.
Milisplastic Div.
2930 N. Ashland Ave., Chicago 13, Ill.

RUGGLES, F. M.
Minnesota Mining & Mfg. Co.
6850 S. Harlem Ave., Bedford Park, Ill.

RUNDGREN, NELS E.
Metalmaster Inc.
5292 Northwest Highway, Chicago 30, Ill.

RUNGE, CARL A.
A. E. Robinson Co.
40 S. Clinton St., Chicago, Ill.

RUSCHMAN, GORDON A.
The Richardson Co.
27th Ave. & Lake St., Melrose Park, Ill.

SABO, WALTER A.
P. R. Mallory Plastics, Inc.
3670 Milwaukee Ave., Chicago 41, Ill.

SAFIANOFF, ALBERT
6142 N. Avers Ave., Chicago, Ill.

SAMELSON, LINCOLN R.
Lake Publishing Co.
718 Western Ave., Lake Forest, Ill.

SANDBERG, K. O. WILLIAM
General Electric Co.
2200 N. 22nd St., Decatur, Ill.

SANDERS, PHILIP H.
Sobenite, Inc.
1026 W. King St., South Bend 16, Ind.

SANGERMAN, M. R.
Nu-Dell Mfg. Co.
2250 N. Pulaski Rd.
Chicago 39, Ill.

SCHARNBERG, JOHN
Logo, Inc.
12933 S. Stony Island Ave., Chicago 33, Ill.

SCHEER, HARRY
320 S. Plymouth St., Chicago, Ill.

SCHIFF, CHARLES
Brever Molding Co.
2536 W. Lake St., Chicago 12, Ill.

SCHLAGER, WILFRED C.
6675 Hiawatha Ave., Chicago 30, Ill.

SCHLEITER, ROBERT F.
Koppers Co., Inc.
122 S. Michigan Ave., Chicago 3, Ill.

SCHLIEM, RICHARD S.
5305 Gilbert, LaGrange, Ill.

SCHLUSSMAN, GILBERT
Continental Can Co., Inc.
2930 N. Ashland St., Chicago 13, Ill.

SCHMIDT, JOSEPH J.
927 Glenayre, Glenview, Ill.

SCHMIDT, ROBERT L.
Barrett Div.
Allied Chemical & Dye Corp.
Chicago 54, Ill.

SCHMITZ, CARL E.
Crane Packing Co.
6400 Oakton St., Morton Grove, Ill.

SCHOELLER, RUSSELL E.
Chicago Molded Products Corp.
1020 N. Kilmar Ave., Chicago, Ill.

SCHRAMN, ROY L.
114 N. Elm St., Mt. Prospect, Ill.

SCHROETER, E. K.
Presco Plastics
P.O. Box 875, Milwaukee, Wis.

SCHULZ, RICHARD O.
Richard O. Schulz Co.
2425 N. 75th Ave., Elmwood Park, Ill.

SCHWARZ, HERBERT F.
The Sherwin-Williams Co.
11541 S. Champlain Ave., Chicago 28, Ill.

SEKOWSKI, JOHN L.
7019 W. Cornelia Ave., Chicago 34, Ill.

SELF, M. A.
515 138th St., Hammond, Ind.

SHANNON, JOHN W.
Whitso, Inc.
9330 Byron St., Schiller Park, Ill.

SHAPERO, WALLACE H.
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Cleveland 14, O.
LEWIS, LAWRENCE
1144 Hillside Rd., Seven Hills
Cleveland 9, O.
LINN, CARL F.
The Watertown Manufacturing Co.
858 Hanna Bldg., Cleveland 15, O.
LINSON, DONALD H.
Ohio Brass Co.
380 N. Main St., Mansfield, O.
LISCOVITZ, GEORGE
7408 Brookside Rd., Cleveland 9, O.
LOPEZ, RICHARD C.
Box 1312, Akron 9, O.
LOVE, WILLIAM C.
Steere Enterprise, Inc.
422 S. Broadway, Akron, O.
LYTLE, WILLIAM W.
60 M. Sharon Rd., Willoughby, O.
MAGEE, JOHN F., JR.
Farrel-Birmingham Co., Inc.
2710 First Nat'l. Tower, Akron 8, O.
MALEK, EDWARD J.
Allied Resins, Inc.
Commerce St., Conneaut, O.
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B. F. Goodrich Chemical Co.
3135 Euclid Ave., Cleveland 15, O.
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North Canton, O.
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MC CLELLAN, ERNEST E.
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R.R. #3, Shaker Blvd., Chagrin Falls, O.
MC CUTCHEON, ROBERT J.
2585 Smith Rd., Akron 13, O.
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1313 Republic Bldg., Cleveland 1, O.
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Hercules Powder Co., Inc.
865 Union Commerce Bldg.,
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MC LAIN, WILLIAM R.
Kusan, Inc.
2716 Franklin Rd., Nashville, Tenn.
MC NASH, HOWARD H.
576 S. Falmouth Dr., Cleveland 16, O.
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Plastic Eng., Inc.
84-8506 Lake Ave., Cleveland, O.
MEDINA, HENRY
Box 412, Thompson, O.
MESSINA, WILLIAM A.
23817 Cliff Dr., Bay Village, O.
MEYER, WALTER H.
9053 Bronx Ave., Skokie, Ill.
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23000 St. Clair Ave., Cleveland, O.
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7301 Grand Ave., Cleveland, O.
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Injection Molders Supply Co.
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159 Highland Ave., Clawson, Mich.

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East Contral Ave., Wichita, Kans.
FRISCHER, GEORGE K.
Holiday Plastics Inc.
1301 Fairfax Trafficway
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GADBERRY, HOWARD M.
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425 Volker Blvd., Kansas City 10, Mo.
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Regal Plastic Co.
2800 E. 14th St., Kansas City, Mo.
GIDEON, WILLIAM P.
Eastman Chemical Products, Inc.
3435 Broadway Blvd., Kansas City 11, Mo.
GREDELL, OTTO N.
Standard Steel Works
16th & Howell St., N. Kansas City 16, Mo.
HEDGES, RALPH C.
Hazelle's Marionettes
905 East 10th St., Kansas City 6, Mo.
HEFLIN, GEORGE W., JR.
Avsco, Inc.
940 Isley Blvd., Excelsior Springs, Mo.
HUGHES, ROBERT L.
Spencer Chemical Co.
1231 Woodswether Rd., Kansas City 5, Mo.
HULSE, GEORGE E.
Spencer Chemical Co.
Dwight Bldg., Kansas City 5, Mo.
IMIG, CHARLES S.
6307 W. 77th Terrace
Overland Park, Kans.
JEAN, MAURICE A.
11691 E. 45 Terrace, Kansas City, Mo.
JONES, R. VERNON
Phillips Chemical Co.
Adams Bldg., Bartlesville, Okla.
KAUFMANN, K. A.
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KIVETT, JEROME S.
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KUCHER, CHARLES G.
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1231 Woodswether Rd., Kansas City 5, Mo.
KUHLMAN, ORVILLE E.
Kuhlman Plastics Co., Inc.
3737 Gardner, Kansas City, Mo.
LUSCUSK, PAUL C.
5101 Southbridge Dr., Kansas City, Kans.
MABRY, GUY O.
Owens-Corning Fiberglas Corp.
2610 Power & Light Bldg.
Kansas City, Mo.
MAGRUDER, WILLIAM R.
Flexcel Container Co.
75th Cleveland, Kansas City, Mo.
MILLINGTON, WILLIAM H., JR.
Spencer Chemical Co.
610 Dwight Bldg., Kansas City 6, Mo.
MOORE, CLARENCE M., JR.
1342 Woodsweather Rd., Kansas City, Mo.
MORRIS, JOHN F.
6535 Lowell St., Merriam, Kans.
ORR, LESLIE G.
605 E. 56th St., Kansas City 10, Mo.
PEILER, WILLIAM H.
Spencer Chemical Co.
1231 Woodswether Rd., Kansas City 5, Mo.
PRELOGAR, W. H.
National Products Co.
6100 Wilson Ave., Kansas City, Mo.
REDMAN, JOHN
Redman Pattern Works
7011 E. 12 St., Kansas City, Mo.
ROUNKLES, CASEY G.
Excelsior Plastics Co.
Marietta & Bluff, Excelsior Springs, Mo.
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Goodyear Tire & Rubber Co.
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HELGESEN, JOHN A.
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330 Great Oaks, Dayton 3, O.

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OVERWEIN, JOSEPH H.
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PAYNE, ALBERT E.
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POTTER, W. D.
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KEMPS, ANTON T.
New Jersey Tool & Die Co.
800 Colfax Ave., Kenilworth, N. J.
KENEN, IRVIN O.
Nixon Nitration Works
Nixon, N. J.
KENNELLY, WILLIAM J., JR.
123 Westview Rd., Upper Montclair, N. J.
KEREKES, T. J.
281 Mt. Prospect Ave., Newark, N. J.
KEUSCH, EDWIN F.
The Fiberite Corp.
33 Oakland Ave., Bloomfield, N. J.
KILLION, FRED T.
5 Park La., Essex Falls, N. J.
KINNEY, PAUL W.
Celanese Corp. of America
290 Ferry St., Newark, N. J.
KLEISER, PAUL
143 Codwise Ave., New Brunswick, N. J.
KLIMOCK, JOHN J.
33 Summit Ave., Garfield, N. J.
KNOWLES, ROGER B.
Northampton Ct., Apt. 4 E,
Amsterdam, N. Y.
KOEGL, RICHARD A.
R. A. Koegl Stamp & Die Works
9 Evans Terminal, Hillside 5, N. J.
KOESTER, RALPH E.
R.F.D. #1, Greenwich, N. Y.
KOOP, NEIL A.
253 Linden, Westfield, N. J.
KOPLITZ, EDWARD O.
179 Green Village Rd., Madison, N. J.
KREIDER, MARTIN L.
141 Marlboro St., Westfield, N. J.
KRESS, GEORGE H.
George H. Kress Associates
24 Commerce St., Newark 2, N. J.
KRESSER, THEODORE O.
173 Ehrhardt Rd., Pearl River, N. Y.
KUCHKUDA, ROMAN W.
519 Gregory Ave., Passaic, N. J.
KUETTEL, G. M.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept.
350 Fifth Ave., New York, N. Y.
LA GRUTTA, PASCAL
La Pin Prod., Inc.
398 N.E. 79th St., Miami, Fla.
LANGE, ARTHUR
Park Plastics Co.
940 Park Ave., Lnden, N. J.
LANZA, JULIAN
Meyersville Rd., c/o Chatham R.F.D.,
Meyersville, N. J.
LEGHORN, KENNETH M.
Sun Tube Corp.
100 Park Ave., New York 17, N. Y.
LEIPOLD, W. C.
Plastic Horizons, Inc.
2 E. 5th St., Paterson, N. J.
LEITER, R. M.
Celanese Corp. of America
290 Ferry St., Newark, N. J.

LERMER, HERMAN B.
Lermer Plastics, Inc.
502 South Ave., Garwood, N. J.

LESTER, WILLIAM M.
Pyro Plastics Corp.
690 Chestnut St., Union, N. J.

LEVY, MURRAY D.
David Kahn, Inc.
Grand Ave. & 11th St., North Bergen, N. J.

LEYES, CHARLES E.
Celanese Corp., Plastics Division
290 Ferry St., Newark 5, N. J.

LICHTENSTEIN, DAN
61 Throckmorton Ave.,
West Long Branch, N. J.

LINZER, ROBERT
23 S. Third Ave., Highland Park, N. J.

LIPTAK, PAUL P.
Rochelle Plastic Mold Co., Inc.
35 Sebago St., Clifton, N. J.

LOMBARD, FRANK A.
1337 Oakland Ave., Union, N. J.

LORDLY, L. CHESTER
R.F.D. #1, Chatham, N. J.

LORENTZ, ROBERT C.
323 Timber Dr., Berkeley Heights, N. J.

LOVALLO, CARMINE
16 Allen St., Irvington, N. J.

LOVALLO, JOSEPH N.
639 Ridge St., Newark, N. J.

LOVELESS, THOMAS L.
34 Leonard Dr., Old Tappan,
Westwood, N. J.

LYNN, EDWIN W.
166 Madison Ave., Irvington 11, N. J.

MABEY, WILLIAM E.
48 Ella St., Bloomingdale, N. J.

MAC ALMON, EDWARD L.
International Business Machines Corp.
South Rd., Poughkeepsie, N. Y.

MACKSEY, KENNETH W.
181 Upper Mountain Ave., Montclair, N. J.

MADDEN, S. G.
B. F. Goodrich Chemical Co.
415 Madison Ave., New York 17, N. Y.

MADDOCK, BRUCE H.
63 Helen St., Fanwood, N. J.

MANN, BASIL E.
Warwick Turnpike, Hewitt, N. J.

MANSFIELD, GEORGE E.
9 Coolidge Ave., West Orange, N. J.

MARCHAK, NICHOLAS
Sun Tube Corp.
181 Long Ave., Hillside, N. J.

MARCY, ROBERT J.
302 W. 12th St., New York 18, N. Y.

MARESCA, ANTHONY M.
1112 Jeffrey Ave., Wanamassa, N. J.

MARGUS, EDWARD A.
Glacier Hills, R.F.D. #1,
Morris Plains, N. J.

MARMEN, J. MARK
298 Jefferson Ave., Salem, Mass.

MARK, WILLIAM A.
442 Grant Ave., Scotch Plains, N. J.

MAUTE, BERNHARD W.
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MAXWELL, BRYCE
Princeton University—Plastics Labs.
Princeton, N. J.

MAYBEE, RODERICK M.
Shell Chemical Corp.
1120 Commerce Ave., Union, N. J.

MAYER, MARK G.
2 Dean Terrace, Union, N. J.

MAYWALD, FREDERICK J.
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MAZZUR, FRANK C.
10 Lenox Ave., Avenel, N. J.

MC BRIDE, EDWARD T.
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MC GUIRE, THOMAS M.
110 Draper La. (L-4), Dobbs Ferry, N. Y.

MC KENNA, LAWRENCE A.
70 Arcadia Rd., Apt. 12 N,
Hackensack, N. J.

MC MILLAN, BRUCE T.
281 Idaho St., Paramus, N. J.

MEARS, VINCENT L.
Vulcanized Rubber & Plastics Co.
1 S. Pennsylvania Ave., Morrisville, Pa.

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65 Goshen St., Paterson, N. J.

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Plastic Molders Supply Co.
74 South Ave., Fanwood, N. J.

MEYER, JOSEPH E.
1020 Evergreen Ave., Plainfield, N. J.

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Sun Tube Corp.
181 Long Ave., Hillside, N. J.

MIKSCH, MATHAN
Newark Die Co.
24 Scott St., Newark, N. J.

MISTRETTA, RAYMOND S.
Gering Products, Inc.
Monroe Ave., Kenilworth, N. J.

MORONEY, JOHN F.
743 Park Ave., Oradell, N. J.

MORSE, GEORGE T.
Smooth-On Mfg. Co., Inc.
572 Communipaw Ave., Jersey City 4, N. J.

MOSS, HIBBERT W.
62 Beekman Rd., Summit, N. J.

MUELLER, EUGENE F.
75 Devonshire Rd., Cedar Grove, N. J.

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33 North St., Syosset, L. I., N. Y.

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108 Prospect Dr., Hightstown, N. J.

NATURALE, ANTHONY
366 Birch Dr., Roselle, N. J.

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Claremont Pigment Dispersion Corp.
39 Powerhouse Rd.,
Roslyn Heights, L. I., N. Y.

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NUFER, ARTHUR
11 Durham Dr., Clark, N. J.

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Shaw Insulator Co.
160 Coit St., Irvington 11, N. Y.

OGANDO, JOSEPH A., JR.
16 Deer Trail Rd., North Caldwell, N. J.

O'HAGAN, WILLIAM D.
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Staten Island 2, N. Y.

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Olsenmark Corp.
124 White St., New York 13, N. Y.

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PALMER, S. E.
Eastman Chemical Products
Kingsport, Tenn.

PARRY, HARVEY L.
56 Mountain Ave., Maplewood, N. J.

PARSEKIAN, RICHARD A.
54 Garfield Pl., Ridgewood, N. J.

PAULUS, GEORGE F.
Congoleum-Nairn, Inc.
195 Belgrove Dr., Kearny, N. J.

PEACOCK, WILLIAM H.
83 Grove St., Elizabeth, N. J.

PEBLY, HARRY E., JR.
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PRASSL, ANTON
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145 Bryant Ave., Springfield, N. J.

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39 Baltusrol Way, Short Hills, N. J.

PREUSS, PETER P.
1852 Lamberts Mill Rd., Westfield, N. J.

PROBST, KARL J.
Pitt-Consol Chemical Co.
A 191 Doremus Ave., Newark, N. J.

PYHEL, HENRY
Hendick Co.
247 Watchung Ave., West Orange, N. J.

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180 Northview Dr., Lancaster, Pa.

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Grace Chemical & Res. Co.
Polymer-Chem. Div.
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REED, GEORGE T.
376 Willard Rd., Paramus, N. J.

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National Aniline
Div. Allied Chem. & Dye Corp.
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Newark Die Hobbing & Casting Co.
24 Scott St., Newark, N. J.

ROBERTSON, IAN
56 Harding St., Blauvelt, N. Y.

RODGERS, WILLIAM C.
159 Summit Ave., Summit, N. J.

ROGERS, JOSEPH C.
21 Raleigh Rd., Washington Park,
Nixon, N. J.

ROMANOWSKI, HENRY J.
10 John St., Nanticoke, Pa.

ROSENHEIM, DAVID J.
28 Parker Ave., Deal, N. J.

ROSS, ERIC F.
Alpha Chemical & Plastics Corp.
11 Jabez St., Newark 5, N. J.

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New Market, P.O. Box 475,
New Market, N. J.

RYAN, E. N.
Universal Cyclops Steel Corp.
P.O. Box 254, Union, N. J.

RYCYK, P. EDWARD
69 Elmwood Terrace, West Caldwell, N. J.

RYK, FRANK
Park Plastics Co.
940 Park Ave., Linden, N. J.

SALA, ARNOLD
National Rubber Machinery Co.
384 Getty Ave., Clifton, N. J.

SANDERS, MILTON A.
171 Tudor Oval, Westfield, N. J.

SANDLER, JACK
Hungerford Plastics Corp.
114 Beach St., Rockaway, N. J.

SAUERMAN, JACK E.
257 Old Post Rd., Nixon, N. J.

SAVAGE, RICHARD J.
Archer-Daniels-Midland Co., Dev. Dept.
P.O. Box 839, Minneapolis, Minn.

SAVITT, KENNETH
321 C-Fuller Dr., New Milford, N. J.

SAYEK, HENRY M.
40 Starr St., Iselin, N. J.

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2 Birch Ave., Pennington, N. J.

SCAVUZZO, JOHN J.
23 Franklin Pl., Carlton Hill, N. J.

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1337 Hidden Circle, Mountainside, N. J.

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211 N. 15th St., Bloomfield, N. J.

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2799 Carol Rd., Union, N. J.

SCHILLER, JULIUS M.
8 Terrace Ave., Hasbrouck Hts., N. J.

SCHMEY, PAUL
Celanese Corp. of America
290 Ferry St., Newark, N. J.

SCHMIDT, PAUL E.
St. Regis Paper Co.
Old National Rd. E., Richmond, Ind.

NEWARK

SCHRAG, WAYNE M.
643 Hanford Pl., Westfield, N. J.
SCHULE, ELMER C.
Allied Chemical & Dye Co.
Columbia Rd., Morristown, N. J.
SCHULTZ, ROBERT S.
Sun Tube Corp.
181 Long Ave., Hillside, N. J.
SCHUSTER, GEORGE J.
Newark Die Co.
24 Scott St., Newark, N. J.
SCRIBNER, GEORGE K.
Boonton Molding Co.
326 Myrtle Ave., Boonton, N. J.
SEITZ, EDWARD F., JR.
46 Tower Hill Rd., Mountain Lakes, N. J.
SERLE, ALLAN G.
2586 Juliat Pl., Union, N. J.
SEVERS, EDWARD T.
Natvar Corp.
Box 67, Rahway, N. J.
SHANLY, JOHN S.
3 Ridgeview Ave., New Providence, N. J.
SHAW, STANFORD H.
Shaw Insulator Co.
160 Colt St., Irvington, N. J.
SHERMAN, JAY D.
25 Shadylawn Dr., Madison, N. J.
SHERMAN, MAX R.
Gering Products, Inc.
N. 7th St. & Monroe Ave.,
Kenilworth, N. J.
SIDUN, CYRIL
Hercules Powder Co.
380 Madison Ave., New York 17, N. Y.
SILLS, M. J.
22 Patton Dr., Bloomfield, N. J.
SKEELS, ARTHUR N.
Art Decorating Co.
4201 Hudson Blvd., N. Bergen, N. J.
SKEIST, IRVING
32 Laurel Ave., Summit, N. J.
SLOAN, JACK
Curtiss-Wright Corp.
Quehanna, Pa.
SMACK, KENNETH G.
Curtiss-Wright Corp.
P.O. Box 351, Caldwell, N. J.
SMITH, DONALD F.
64 Harrington Rd., Clifton, N. J.
SMITH, HERBERT A. T.
4 Colonial Green, Westport, Conn.
SMITH, RICHARD A.
M. W. Kellogg Co.
P.O. Box 469, Jersey City 3, N. J.
SMITH, WALTER F., JR.
Boonton Molding Co.
326 Myrtle Ave., Boonton, N. J.
SMOLUK, GEORGE R.
The Bakelite Co.
30 E. 42nd St., New York 17, N. Y.
SORG, E. H.
Thiokol Chemical Corp.
780 N. Clinton, Trenton 7, N. J.
SOULES E. B.
Detroit Mold Engineering Co.
1217 Central Ave., Hillside, N. J.
SPAAK, ALBERT
199 First Ave., Little Falls, N. J.
SPENCER, CHARLES D.
Karla Dr., Whippany, N. J
SPITZIG, EDMUND W.
Newark Die Co.
24 Scott St., Newark, N. J.
STAAB, GEORGE J.
27 Addison Dr., Short Hills, N. J.
STALBAUM, RALPH H.
747 Kimball Ave., Westfield, N. J.
STANLEY, FRED B.
101 Sequams La., W., Babylon, L. I., N. Y.
STANTON, JOHN L.
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30 Rockefeller Plaza, New York 20, N. Y.
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Newburgh Plastics Corp.
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STERN, J. J.
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STEUER, EGON
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STEWART, JAMES M.
The Dolphin Molding Co., Inc.
90-23rd St., Newport News, Va.
STINE, HERBERT C.
R.F.D., Millington, N. J.
STIVALA, SALVATORE
13-178 Sampson Rd., Fair Lawn, N. J.
STOKES, W. J. B., II
Electromold Corp.
140 Enterprise Ave., Trenton 9, N. J.
STOWARZ, TERRY C.
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STURKEN, ROBERT C.
Frank W. Egan & Co.
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SULLIVAN, GERALD S.
Shasta Mfg. Co.
276 Snyder Ave., Berkeley Heights, N. J.
SULLIVAN, MICHAEL W.
Star Rt., Sussex Ave., Morristown, N. J.
SUNDSTROM, GUNNAR
Greenbarn Rd., Long Valley, N. J.
SWARTZ, C. KENNETH
Consolidated Molded Products Corp.
309 Cherry St., Scranton 2, Pa.
SWEENEY, JOHN J.
The Okonite Co.
220 Passaic St., Passaic, N. J.
SWENSON, VICTOR H., JR.
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SWOREN, WILLIAM
1356 Hamilton St., Elizabeth 3, N. J.
SZARAWARSKI, CHESTER
150 Shaw St., Garfield, N. J.
TANIS, EDWARD
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THOMAS, ISLYN
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TICKNER, E. C.
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TIGNER, ROBERT E.
Hoover Color Corp.
13 Cordier St., Irvington, N. J.
TILP, ROBERT F.
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TIMPF, HENRY C.
Celanese Corp. of America
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TISCH, HENRY A.
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TORAU, GUNTHER W.
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WALKER, BENJAMIN M.
Resistoflex Corp.
Roseland, N. J.
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WEINBERG, MARK H.
Prod. Eng. Labs. Co., Inc.
314 Adams St., Newark 5, N. J.
WEISS, MILTON
Colorite Plastics of New Jersey, Inc.
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WHEELER, KENNETH A.
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WHEELER, PEYTON
Minerals & Chemicals Corp. of America
Menlo Park, N. J.
WHITE, ROBERT A.
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WHITESCARVER, WILMER F.
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WHITNEY, ALVA E., JR.
Goodyear Tire & Rubber Co.
292 Madison Ave., New York 17, N. Y.
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Princeton Pkway & Vassar Rd.
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ZIEGFELD, C. J.
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JURGENSEN, DELBERT F.
Congoleum-Nairn, Inc.
195 Belgrove Dr., Kearney, N. J.

KADIN, STANLEY S.
453 Richard Ave., Staten Island 9, N. Y.

KAFKA, FREDERICK M.
Superior Materials Inc.
120 Liberty St., New York 6, N. Y.

KAIRATH, HOWARD G.
159-19 99 St., Howard Beach 14, N. Y.

KALEY, DUDLEY
One Gateway Center, Pittsburgh 22, Pa.

KAMINSKY, PHILIP F.
Alynn Metal & Plastic Products
309 Fifth Ave., New York 16, N. Y.

KANARVOGEL, LEON
54 Acre La., Hicksville, N. Y.

KAPLAN, BENJAMIN B.
Bentek Co.
1253 Atlantic Ave., Brooklyn 16, N. Y.

KARMEL, LEONARD
168 Roberta St., Valley Stream, N. Y.

KATZ, ABRAHAM M.
Ideal Plastics Corp.
184-10 Jamaica Ave., Hollis, N. Y.

KEARNS, JAMES W., JR.
170 Lake Dr., E., Packanack Lake, N. J.

KERN, ROY L.
8701 Shore Rd., Brooklyn 9, N. Y.

KETTLER, LOUIS
941 Jerome Ave., New York 52, N. Y.

KEVILLE, JOHN J.
Brea Chemicals, Inc.
1060 International Bldg., 45
Rockefeller Plaza, New York 20, N. Y.

KHACHADOORIAN, ZAVAN T.
87 Putnam Park Apartments
Millbank Rd., Greenwich, Conn.

KING, WILLIAM E.
Barber-Colman Co., Wheelco Inst. Div.
66 Hudson St., Hoboken, N. J.

KINSEY, ISAAC, III
33 Monroe Ave., Larchmont, N. Y.

KLEIDERER, CHARLES W.
87 E. Williston Ave., East Williston, N. Y.

KLUEGER, MAX
Omni Products Corp.
460—4th Ave., New York 16, N. Y.

KNIGHT, RALPH M.
National Distillers Products Corp.
99 Park Ave., New York, N. Y.

KNOTT, DONALD M.
Chas. Pfizer & Co.
630 Flushing Ave., Brooklyn 6, N. Y.

KOBAK, ROBERT R.
Westchester Plastics, Inc.
326 Waverly Ave., Mamaroneck, N. Y.

KOCHIS, STEPHEN N.
International Business Machines Corp.
Dept. 587, South Rd., Poughkeepsie, N. Y.

KOLLMEIER, XAVIER
International Business Machines Corp.
South Rd., Poughkeepsie, N. Y.

KOSIN, CHESTER L.
123-41 146th St., Ozone Park 20, L. I. N. Y.

KOVALIK, KENNETH J.
Empire Bushes, Inc.
200 William St., Port Chester, N. Y.

KOZMA, GEORGE
12 Patience La., Westbury, L. I., N. Y.

KRAMER, MARVIN S. W.
67-66 150th St., Flushing 67, N. Y.

KREIZEL, WILLIAM J.
Richards La., Hewlett Harbor, N. Y.

KRETKOWSKI, BEN
Plastic Materials, Inc.
589 Main St., Westbury, L. I., N. Y.

KRONE, FREDERICK A.
655 E. 7th St., Plainfield, N. J.

KUFFLER, H. F.
Baby World Co., Inc.
36-31 33st St., L. I. 6, N. Y.

LACHINA, PETER
Mach. & Metal Trades Tech. &
Voc. High School
320 E. 96th St., New York 28, N. Y.

LAMY, FREDERICK
110 W. 96th St., New York 25, N. Y.

LANDSBERGER, GERARD
41-46 50th St., Woodside, L. I., N. Y.

LANE, ROBERT M.
Life Plastics Co.
1123 Flushing Ave., Brooklyn, N. Y.

LARKIN, EDWARD L., JR.
Monsanto Chemical Co.
445 Park Ave., New York, N. Y.

LAUTIN, LEON
Lautin Plastics
Jericho Turnpike, Country House Rd.,
P.O. Box 231, New Hyde Park, L. I., N. Y.

LAX, HAROLD
Plastic Fabricators Corp.
220 E. 134th St., Bronx 54, N. Y.

LEIDEL, WILLIAM F., JR.
Fred Wacker Co.
40-17 22nd St., Long Island City, N. Y.

LEIMSEIDER, EDWARD B.
World Plastex
1685 Boone Ave., New York 60, N. Y.

LEMONIER, C. R.
724 Jericho Turnpike, Westbury, N. Y.

LENS, KARL G.
Crest Chemical Ind. Corp.
72 Delavan St., Brooklyn 31, N. Y.

LENSKY, ALBERT
620 E. 20th St., New York 9, N. Y.

LERMAN, JERRY
87-06 51st Ave., Elmhurst 73, N. Y.

LEVIN, MONTE L.
Monte L. Levin Co.
501 Madison Ave. New York 22, N. Y.

LEVINE, BERNARD B.
Bernard Plastics Molding Corp.
38-40 10th St., Long Island City, N. Y.

LEWI, WILLIAM
Dusal Tool & Mold Co., Inc.
37-01 Vernon Blvd.,
Long Island City 1, N. Y.

LEWIS, DANIEL
2370 Ocean Ave., Brooklyn, N. Y.

LEWIS, JEROME
Toy Industries, Inc.
84 Clifton Pl., Brooklyn 38, N. Y.

LEWIS, ROBERT
Regent Plastics, Inc.
265 Greene Ave., Brooklyn 38, N. Y.

LEWIS, SEYMOUR
154 Elro Ave., Glen Cove, L. I., N. Y.

LISS, JACK
Marbek, Inc.
1200 Manhattan Ave., Brooklyn 22, N. Y.

LOESING, JOSEPH B., JR.
The Richardson Co.
75 West St., New York City 6, N. Y.

LOUDEN, LILYON E.
Consumer & Industrial Public Relations Co.
55 W. 42nd St., New York 36, N. Y.

LUCKOW, JOSEPH
Victory Mold & Die Co.
53 W. 36 St., New York 18, N. Y.

LUNN, JAMES S.
Lunn Laminates, Inc.
Oakwood Rd. and W. 11 St.
Huntington Station, N. Y.

LUPO, JOSEPH
26 E. Cedar St., Mt. Vernon, N. Y.

MAASSEN, GUSTAV C.
R. T. Vanderbilt Co., Inc.
33 Winfield St., East Norwalk, Conn.

MACCAFERRI, MARIO
Mastro Plastics Corp.
3040 Webster Ave., Bronx 67, N. Y.

MACKEY, ERIC
The Borden Co., Chemical Div.
350 Madison Ave., New York, N. Y.

MACKENZIE, W. B.
Phelps Dodge Copper Prod. Corp.
Habirshaw Cable & Wire Div.
Foot of Point St., Yonkers, N. Y.

MAFFIA, JOHN
Toy Industries, Inc.
84 Clifton Pl., Brooklyn 38, N. Y.

MAGEE, ROBERT C.
Thomson Industries, Inc.
Nassua Terminal Rd.,
New Hyde Park, L. I., N. Y.

MAIBRUNN, MYRON
Robinson Plastics Corp.
132 Lafayette St., New York 13, N. Y.

MAISEL, MELVIN L.
84 Bateman Pl., Mount Vernon, N. Y.

MARCUCILLI, ARMAND
65 Nelson Ave., Harrison, N. Y.

MARCUS, PAUL
1995 Sedgwick Ave, New York 53, N. Y.

MARK, RICHARD
The Castel, Apt. 4, Dobbs Ferry, N. Y.

MARLOWE, MURRAY
Claremont Pigment Dispersion Corp.
39 Powerhouse Rd., Roslyn Heights, N. Y.

MARQUARDT, CARL G., JR.
15 Park Dr., Livingston, N. J.

MARTIN, ELIZABETH D.
115 Sullivan St., New York 12, N. Y.

MARTIN, MAURICE
430 Nepperhan, Yonkers, N. Y.

MARTINELLI, GUY A.
Sylvan Plastics, Inc.
1617 Penna. Blvd. Philadelphia 3, Pa.

MASS, HERBERT M.
602 Derby Dr., E., Oceandise, L. I., N. Y.

MAYURNIK, GEORGE
139 Union Ave., Garfield, N. J.

MAZOFF, MICHAEL
120 Soifer Ave., N. Bellmore, N. Y.

MAZZARELLI, AUGUST M.
Neo-Line Products Corp.
7510 Rockaway Blvd., Woodhaven, N. Y.

MAZZARELLI, FRANK
Neo-Line Products Corp.
7510 Rockaway Blvd., Woodhaven 21, N. Y.

MC BRIDE, JOHN S.
Owens-Corning Fiberglas Corp.
Ashton, R. I.

MC CANN, HIRAM
Modern Plastics, Inc.
675 Madison Ave., New York 22, N. Y.

MC CARTHY, VINCENT D.
National Distillers Co.
U. S. Industrial Chemical Div.
New York 16, N. Y.

MC CAULEY, DONALD S.
64 Jester La., Levittown, N. Y.

MC FARLAND, RICHARD M.
Food Machinery & Chemical Corp.
161 E. 42nd St., New York 17, N. Y.

MC GRATH, MAURICE F., JR.
J. M. Huber Corp.
100 Park Ave., New York 17, N. Y.

MEACHAM, FRED C.
Northern Industrial Chemical Co.
441 Lexington Ave., New York 17, N. Y.

MECKAUER, HENRY P.
Interplastics Corp.
654 Madison Ave., New York 21, N. Y.

MEGLINO, NICHOLAS
213 Shepherd Ave., Brooklyn 8, N. Y.

MEKLEMBOURG, HARRY L.
Progressive Plastics Mfg. Co.
175 E. 153 St., New York 51, N. Y.

MELCHORE, JAMES A.
American Cyanamid Co.
Plastics & Resins Div.,
30 Rockefeller Plaza, New York 20, N. Y.

MENKEL, GARY G.
150-12 85th Dr., Jamacia 32, N. Y.

MERCK, WALTER J.
M. W. Kellogg Co.
P.O. Box 469, Jersey City, N. J.

MERRILL, ARTHUR M.
Plastics Technology
386 Fourth Ave., New York 16, N. Y.

MERZ, PETER H.
90 Beech St., Floral Park, N. Y.

METZGER, ARTHUR
21 Shadetree La., Roslyn Hgts, N. Y.

METZGER, PAUL J.
Hercules Powder Co.
900 Market St., Wilmington 99, Dela.

MEYER, ARNOLD M., JR.
245 Eastchester Rd., New Rochelle, N. Y.

MEYERS, GEORGE E.
308 Red Maple Dr., Levittown, N. Y.

MIALE, PETER M.
Astor Tool & Die Co.
5—01 47th Rd. Long Island City, N. Y.

MILES, ROBERT E.
36 Peachtree La.,
Huntington Station, L. I., N. Y.

MILLER, JEROME L.
15 Deerpark Rd., Great Neck, N. Y.

MILLER, MICHAEL
Miller Plastics, Inc.
130-28 91st Ave., Richmond Hill 18, N. Y.

MILLS, ROBERT J.
Grumman Aircraft
Tool Engr. Plant 3
Bethpage, L. I., N. Y.

MODIGLIANI, D. P.
Modigliani Glass Fibers, Inc.
55 W. 42 St., New York 36, N. Y.

MONACO, FOSTER
Mastercraft Plastics Co., Inc.
95-01 150 St. Jamaica 35, N. Y.

MONACO, ROE
Mastercraft Plastics Co., Inc.
95-01 150 St., Jamaica 35, N. Y.

MONACO, SAM
Mastercraft Plastics Co., Inc.
95-01 150 St., Jamica 35, N. Y.

MONAGHAN, GERALD J.
89-20 55th Ave., Elmhurst 73, L. I., N. Y.

MONTI, PETER D.
21 Hazel Pl., Lynbrook, N. Y.

MORGENSTERN, HENRI
242 W. 38 St., New York 18, N. Y.

MORRIS, JAMES J.
70 Laurel Dr., Massapequa Park, N. Y.

MOSS, JOHN
Extrudo Film Corp.
36-35 36th St., Long Island City 6, N. Y.

MOSS, NATHAN S.
Stafford Mfg. Co., Inc.
145 58th St., Brooklyn, N. Y.

MOTTEN, ROGER H., JR.
Marathon Electric Mfg., Corp.
12 & Cranberry Sts., Erie, Pa.

MUNNS, DAVID A.
The Bakelite Co.
30 E. 42nd St., New York, N. Y.

MURPHY, THOMAS P.
Spencer Chemical Co.
500 Fifth Ave., New York, N. Y.

MURRAY, ALBERT H.
Murray Plastics Co.
26 Cottage St., Poughkeepsie, N. Y.

MYLES, JAMES R.
I.C.I. (New York) Ltd.
488 Madison Ave., New York 22, N. Y.

MYLES, WILLIAM A.
Channel Master Corp, Ellenville, N. Y.

NADEL, MURRAY
463 Pelham Rd., New Rochelle, N. Y.

NAJAR, THOMAS J.
Poly Plastic Products, Inc.
2 Fourth Ave., Paterson, N. J.

NAMM, ARTHUR B.
27 Schoolhouse La.,
Lake Success, L. I., N. Y.

NEHEMIAH, MAURICE A.
Neehi Protective Coatings, Inc.
340 West Hoffman Ave.,
Lindenhurst, N. Y.

NESTER, J. E.
262 Central Park West
New York 24, N. Y.

NILO, SAVATORE C.
Hilltop Rd., R.R. #2, So. Sudbury, Mass.

NOBLE, SID
223 Elm Dr., E., Levittown, L. I., N. Y.

NOCK, T. G.
Shell Chemical Corp.
50 W. 50th St., New York 20, N. Y.

NOE, LEON R.
Bill Brothers Publishing Corp.
386 Fourth Ave., New York 16, N. Y.

NORTHROP, GEORGE S.
1701 Lehigh Rd., Wantagh, N. Y.

NUSSBAUM, FRANK J.
Riverside Plastics Corp.
Miller Rd., Hicksville, N. Y.

O'BRIEN, GEORGE M.
U.S. Industrial Chemicals Div.
Nat'l Distillers Products Corp.
99 Park Ave., New York, N. Y.

O'CONNELL, JOHN J.
Shell Chemical Corp.
380 Madison Ave., New York 17, N. Y.

OETTINGER, HENRY, JR.
91-09 71st Ave., Forest Hills, N. Y.

OLSEN, MARTIN A.
Olsenmark Corp.
124 White St.,New York 13, N. Y.

O'NEIL, FRANK V.
Frank V. O'Neil Color Corp.
46-45 Vernon Blvd.
Long Island City 1, N. Y.

OPPENHEIM, JOSEPH G., JR.
115 Ashland Rd., Brooklyn, N. Y.

ORLOFF, DALE L.
2000 Quentin Rd., Brooklyn 29, N. Y.

ORTNER, JOHN F.
3152 Main St., Buffalo, N. Y.

OVERHOLT, G. T., JR.
Briar Brae, Rd., Stamford, Conn.

PACIA, FRANK
60-11 Maspeth Ave., Maspeth 78, N. Y.

PAMATAT, CLINTON A.
United Mask & Novelty Co.
70-02 70th Ave., Brooklyn 27, N. Y.

PAMATAT, ELWOOD G.
United Mask & Novelty Co.
70-02 70th Ave., Brooklyn 27, N. Y.
PANDOLFO, GEORGE
643 E. 223 St., New York, N. Y.
PARK, FORD R., JR.
McGraw-Hill Publishing Co.
Product Engineering Magazine
330 W. 42nd St., New York 36, N. Y.
PARKER, WILLARD G.
559 Joralemon St., Bellville 9, N. J.
PARTRIDGE, HOWARD W.
Victor Kelloring, Inc.
955 E. 51st. St., Brooklyn 3, N. Y.
PASTORE, RONALD M.
14 Tecumesh Ave., Mount Vernon, N. Y.
PATRICK, ROBERT J.
3429 Hawthorne Dr., S., Wantagh, N. Y.
PEARL, CURTIS F.
Arnkurt Associate Engineers
31 E. 27th St., New York 16, N. Y.
PEARLMAN, JOSEPH
Kwik-Mold Plastics Corp.
247 W. 67th St., New York 23, N. Y.
PELIKAN, ROLF
430 E. 20th St., New York 9, N. Y.
PERLMAN, HARRY
Reliance Plastic Corp.
71 E. Sunrise Hgwy., Freeport, N. Y.
PERLMUTTER, CHARLES
383 Atkins Ave., Brooklyn 8, N. Y.
PERRINE, J. FRANKLIN
87 Jefferson St., Garden City, L. I., N. Y.
PERRY, NORMAN L.
Argus Chemical Co.
633 Court St., Brooklyn 31, N. Y.
PETERSEN, FRED F.
2124-38th St., Long Island City 5, N. Y.
PFAFF, WILLIAM G.
14 A Addison Pl., Clifton, N. J.
PHILLIPS, DANIEL N.
The Bakelite Co.
30 E. 42nd St., New York 17, N. Y.
PHILIPSON, PAUL P.
4143 39th Pl., Sunnyside, N. Y.
PLASKETT, CLYDE A.
St. Regis Paper Co.
Carthage, N. Y.
PLISCO, WILLIAM P.
William P. Plisco Co.
62 Schenectady Ave., Brooklyn 13, N. Y.
POWAZI, JOSEPH
Marveleye Plastics, Inc.
421 Neptune Ave., Brooklyn, N. Y.
POWELL, RICHARD E.
11 Wallace Ave., Baldwin, N. Y.
PREISS, HERBERT
Plastic Materials, Inc.
New South Rd., Hicksville, N. Y.
PRESCOTT, FRANCIS J.
Commercial Chemical Develop. Div.
General Aniline & Film Corp.
435 Hudson St., New York, N. Y.
PRICE, WARREN L.
8524-87 St., Woodhaven 21, N. Y.
PROSKE, HERBERT
2 Lincoln Ave., Ardsley, N. Y.
QUINLAN, JOSEPH
3430—208 St., Bayside, L. I., N. Y.
RADER, JOHN
38-39 Crescent St.,
Long Island City 1, N. Y.
RAFF, HERBERT L.
3664 Richard La., Levittown, L. I., N. Y.
RAINVILLE, DEWEY
The Rainville Company, Inc.
647 Franklin Ave., Garden City, N. Y.
RANDOLPH, HARMON H.
Dingmans Ferry, Box 216, Pike County, Pa.
RESNEK, DAVID L.
2121 Beekman Pl., Brooklyn 25, N. Y.
RHODES, MICHAEL S.
617 E. 12th St., New York 9, N. Y.
RICE, GEORGE H.
Emsig Mfg. Co., 225 W. 60th St.
New York 23, N. Y.
RIE, JOHN L.
2 Corwood Rd., Bronxville, N. Y.
RILEY, MALCOLM W.
Reinhold Publishing Corp.
430 Park Ave., New York 22, N. Y.
RIZZO, PETER J.
The Bakelite Co.
30 E. 42nd St., New York 17, N. Y.
ROBB, PHIL F.
Hercules Powder Co.
380 Madison Ave., New York 17, N. Y.
ROBERTS, KENNETH G.
1064 New York Dr., N. Massapequa, N. Y.
ROBINSON, IRWIN H.
Robinson Plastics Corp.
132 Lafayette St., New York 13, N. Y.
ROGOW, CHARLES M.
20-24 Seagirt Blvd., Apt. 6E.
Far Rockaway 91, N. Y.
ROHER, WILLIAM C., JR.
Box 52, Vernon, N. J.
ROSENBERG, ABRAHAM
Rosenberg Bros. & Co.
Smithtown, L. I., N. Y.
ROSENBERG, ALBERT
735 Pelham Parkway, New York 67, N. Y.
ROSENBERG, JOSEPH H.
Rosenberg Bros. & Co.
Smithtown, L. I., N. Y.
ROSENBERG, PHILIP
19 Cedar Rd., Westbury, N. Y.
ROSENBERG, ROSS
Rosenberg Bros. & Co.
Smithtown, L. I., N. Y.
ROSENSAFT, MELVIN
98 Washington St., Leominster, Mass.
ROSENTHAL, ALFRED A.
Rosenthal Plastics & Engineering
3 Park Row, New York 7, N. Y.
ROSS, ALEXANDER
Novo Plas Mfg. Co., Inc.
47 Rodney St., Brooklyn 1, N. Y.
ROSS, JESSE
Ross Industrial Services
61 Broadway, New York 6, N. Y.
ROTHENSTEIN, GUY G.
50-02 23rd St., Long Island City 1, N. Y.
RUBIN, ARTHUR R.
9 Dorthea St., Plainview, N. Y.
RUNFOLA, CHRISTY J.
Koppers Co. Inc.
430 Park Ave., New York, N. Y.
RUSSELL, HARRY A.
5025 Arlington Ave., New York, N. Y.
SABARY, VICTOR E., JR.
The Luzerne Rubber Co.
Muirhead Ave., Trenton 7, N. J.
SACHER, ALEX
Standard Insulation Co.
74 Paterson Ave., E. Rutherford, N. J.
SALAD, HARRY
383 E. 17th St., Brooklyn, N. Y.
SALATA, JOHN
126 N. 5th St., Brooklyn, N. Y.
SALLESE, VINCENT N.
64-03-229th St., Oakland Gardens 64, N. Y.
SAPERY, STANLEY
Augusta Plastics, Inc.
3820 Boston Post Rd., Bronx 69, N. Y.
SAX, HENRY
110-21 197th St., Hollis 12, N. Y.
SAYLOR, RICHARD E.
Koppers Co., Inc.
430 Park Ave., New York 22, N. Y.
SBAR, MOSES
Tico Plastics, Inc.
55 W. 13th St., New York, N. Y.
SCHATZ, JOEL
64-16 110th St., Forest Hills, N. Y.
SCHEIDL, JOHN
Scheidl Manufacturing Co.
Great Neck Rd., Copiagur, N. Y.
SCHIFF, LEONARD
Caldwell Prod., Inc.
14 Pelham Pkwy, Pelham Manor, N. Y.
SCHLANG, EDWIN A.
Waljohn Plastics, Inc.
437 88th St., Brooklyn, N. Y.
SCHMIDT, JACK W.
218-33 Hillside Ave., Queens Village, N. Y.
SCHNEBLE, FREDERICK W., JR.
Photocircuits Corp.
31 Sea Cliff Ave., Glen Cove, L. I., N. Y.
SCHNEIDER, MYLES Z.
88 Van Sicklen St., Brooklyn 23, N. Y.
SCHNER, CHARLES, JR.
Buttondex Corp.
386—4th Ave., New York 16, N. Y.
SCHOENAU, HENRY
Plastiline, Inc.
2 Intervale St., White Plains, N. Y.
SCHOR, HAROLD
114 E. 40th St., New York 16, N. Y.
SCHOTLAND, MURRAY
Gibson-Thomsen Co., Inc.
10 E. 39 St., New York 16, N. Y.
SCHWARTZ, HAROLD H.
75 Putnam Dr., Port Chester, N. Y.
SCHWARTZ, MARTIN W.
Channel Master Corp.
Ellenville, N. Y.
SCOFIELD, CLEM F.
400 Rosedale Ave., White Plains, N. Y.
SEBOROWSKY, FRANK E.
Celanese Corp. of America
180 Madison Ave., New York 16, N. Y.
SECRETO, ALBERT
Alcorp, Inc.
247 Centre St., New York 13, N. Y.
SELIG, ALLAN H.
245 E. Gunhill Rd., New York 67, N. Y.
SEUBERT, ROBERT F.
Koppers Company, Inc., Chemical Div.
430 Park Ave., New York 22, N. Y.
SHAFFER, ABE
61-20 Littleneck Pkwy., Little Neck, N. Y.
SHANOK, JESSE P.
Glass Laboratories, Inc.
863 65th St., Brooklyn 20, N. Y.
SHARP, T. W.
The Bakelite Co.
30 E. 42nd St., New York 17, N. Y.
SHERIDAN, DAVID S.
National Catheter & Inst. Co.
Box #147, Argyle, N. Y.
SHERMAN, JACK
50 Dakfield Ave., Freeport, L. I., N. Y.
SHERMAN, ROBERT W.
The Bakelite Co.
30 E. 42nd St., New York 17, N. Y.
SHEVETT, ROBERT
520 West End Ave., Apt. 8,
New York 24, N. Y.
SHIFFMAN, JEROME
Standard Unbreakable Watch Crystals, Inc.
123 E. 144th St., Bronx 51, N. Y.
SHINE, WILLIAM
503 Orange Ave., Cranford, N. J.
SHLAFMITZ, ABE
Vacuum Metalizing Corp.
32-36 Greenpoint Ave.,
Long Island City 1, N. Y.
SHLUGER, GEORGE
Continental Extrusion Corp.
30 Prince St., Brooklyn 1, N. Y.
SIMON, LEONARD
704 Howard Ave., Brooklyn 12, N. Y.
SIMON, SYLVAN S.
Walter Kidde & Co., Inc.
675 Main St., Belleville 9, N. J.
SIMONS, HENRY N.
American Vinyl Corp.
73-30 Grand Ave., Maspeth, L. I., N. Y.
SINDEL, HOWARD B.
1475 Wythe Pl., New York 52, N. Y.
SINGER, EUGENE J.
150-38 77th St., Flushing 67, N. Y.
SISSON, JAMES B.
St. Regis Paper Co.
Carthage, N. Y.
SKIDMORE, RUSSELL H.
Celanese Corp. of America
180 Madison Ave., New York 16, N. Y.
SLOANE, GERARD H.
H. Kohnstamm Co., Inc.
87 Park Pl., New York, N. Y.
SLOBODZINSKI, ADOLPH E.
94-30 77th St., Ozone Park, N. Y.
SMITH, ALLEN B.
Turner Halsey Co.
40 Worth St., New York 13, N. Y.
SMITH, S. J.
Mercer Rubber Corp.
Rt. 46 & Huyler St., Little Ferry, N. J.
SMOLKA, GEORGE
Pantasote Co.
26 Jefferson St., Passaic, N. J.
SOKOL, BENJAMIN
Republic Aviation Corp.
Farmingdale, N. Y.
SPALTER, LEO
Progressive Plastics Co.
175 E. 153rd St., New York 51, N. Y.
SPARROW, LAWRENCE R.
138-36 68 Dr., Flushing 67, L. I., N. Y.
SPEIER, ALBERT K.
667 Hawthorn, Brooklyn, N. Y.
SPIELMAN, SIMON S.
834 Far Rockaway Blvd.,
Far Rockaway 91, N. Y.
SPORING, WILLIAM F.
485 Gramatan Ave., Mt. Vernon, N. Y.
STADTLER, WALTER A.
37 Rockbridge Dr., Port Chester, N. Y.
STARIN, J. A.
Harry T. Campbell Sons' Corp.
Towson St., Baltimore 4, Md.
STECKER, FRED
104-17, 129th St., Richmond Hill 19, N. Y.
STEINER, PHILLIP L.
7 Valley Pl., Tenafly, N. J.
STILWELL, WILLIAM M., III
Climax Molybdenum Co.
500 Fifth Ave., New York 36, N. Y.
STOPEK, BENJAMIN
466 Steven Ave., Buxton House #57,
W. Hempstead, N. Y.
STOTT, RICHARD F.
Stott Tool & Machine Co.
61 E. Second St., Mineola, N. Y.
STREGACK, B. MARTIN
A.B.S. Mfg. Co., Inc.
133 W. 19th St., New York 11, N. Y.
STREIFER, HERBERT
Model Plastic Corp.
85 S. Kensico Ave., White Plains, N. Y.
STRULLY, HERMAN
Plastic Fabricators Corp.
220 E. 134th St., Bronx 54, N. Y.
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COHEN, IRVIN M.
ABC Plastic Fabricators
825 Arch St.
Philadelphia 7, Pa.

COLBY, H. C., JR.
600 Elm Terrace, Riverton, N. J.

COLLETTE, McKAY
Glen Mills, Pa.

CONSOLLOY, JAMES W.
Oak St.
Pennington, N. J.

CONWELL, ROBERT P.
121 Spring House Rd.
Merchantville 9, N. J.

COOK, FRANK E.
909 Jefferson Ave.
Erlton, N. J.

COOPER, EDWARD B.
E. I. de Pont de Nemours & Co., Inc.
Polychemicals Dept.
Experimental Station—Bldg. #323
Wilmington, Dela.

COULL, WALLACE W.
Willson Products Div.
Ray-O-Vac Co., P.O. Box 622
Reading, Pa.

COUPERUS, P. G.
2123 Pleasant Ave.
Glenside, Pa.

CRANE, P. WILLARD
Cincinnati Milling Products Division
Cincinnati Milling Machine Co.
4701 Marburg Ave.
Cincinnati 9, O.

CREAMER, WALTER P.
Dow Chemical Co.
400 Market St.
Camden, N. J.

CRONIN, EDWARD W.
Hercules Powder Co.,
Wilmington 99, Dela.

CULWICK, EDWARD F.
Winner Mfg. Co., Inc.
Box 399
Trenton 3, N. J.

CYPHERS, H. W.
The Borden Co.
5000 Summerdale Ave.
Philadelphia 24, Pa.

DARBY, HARRY L.
Winner Manufacturing Co., Inc.
Box #399
Trenton 3, N. J.

DARLINGTON, H. S.
A. H. Wirz, Inc.
2300 W. 4th St.
Chester, Pa.

DARNELL, WILLIAM H.
E. I. du Pont de Nemours Co., Inc.
Polychemicals Dept., Exp. Sta.
Wilmington 98, Dela.

DAUPHINAIS, GEORGE A.
Quaker Rubber Co.
Tacony & Comley St.
Philadelphia 24, Pa.

DAVIS, CHARLES C., JR.
Stokes Trenton, Inc.
Box #213
Trenton 9, N. J.

DAVIS, GEORGE E.
Warminster Rd., at Moreland Ave.
Hatboro, Pa.

DAVIS, W. J.
Polymer Corp.
Reading, Pa.

DeHOFF, GEORGE R., JR.
10003 Wagoner Dr.
Woodland, Wilmington 5, Dela.

DELANEY, JAMES E., JR.
F. J. Stokes Machine Co.
5500 Tabor Rd.
Philadelphia 20, Pa.

DENNISON, DAVID L.
E. I. de Pont de Nemours & Co., Inc.
Wilmington, Dela.

DERHAM, PHILIP A.
Bryn Mawr Theater Building
Bryn Mawr, Pa.

DERMODY, WILLIAM J.
Electric Storage Battery Co.
Adams & Rising Sun, Philadelphia 20, Pa.

DEROWSKI, EDWARD
Penn Plastics Co.
Glenside, Pa.

DODDS, WILLIAM R.
Maryland Plastics, Inc.
251 E. Central Ave.
Federalsburg, Md.

DUKERT, A. A.
48 Mead Rd.
Broad Axe Village
P.O., Ambler, Pa.

DUNDORE, D. D.
Westlake Plastics Co.
West Lenni Rd.
Lenni Mills, Pa.

DUTTON, FREDERICK O.
348 E. 2nd St.
Moorestown, N. J.

EARLEY, JAMES J.
551 Maplewood Ave.
Springfield, Pa.

EDMUNDS, EDMUND J.
101 N. Lexington Ave.
Havertown, Pa.

EDMUNDS, W. HAROLD
104 Harvard Rd.
Havertown, Pa.

EGOLF, CHARLES B.
Rohm & Haas Co.
Bristol, Pa.

ERNST, RICHARD T.
121 Ballanca La.
New Castle, Del.

FEDAK, DANIEL W.
Box 66
Prompton, Pa.

FEHR, ROY B., JR.
110 Cambridge Dr.
Windsor Hills,
Wilmingham, Del.

FELS, ARTHUR M.
Atlantic Mfg. Co.
9th & Master Sts.
Philadelphia 22, Pa.

FEUER, SEYMOUR S.
38 Brookside Dr.
Feasterville Pa.

FISCHER, JOHN J.
Patterson Kelley Co., Inc.
East Stroudsburg, Pa.

FITZPATRICK, EDWARD
F. J. Stokes Machine Co.
Olney Post Office
Philadelphia 20, Pa.

FLECK, ROBERT D.
C. D. F. Co.
Continental Diamond Co.
Newark, Del.

FOLEY, WILLIAM E.
E. I. du Pont de Nemours & Co., Inc.
Polychemicals Div.
Chestnut Run, Wilmington, Del.

FOX, BENJAMIN
403 Gribbel Rd.
Wyncote, Pa.

FRANTA, WILLIAM A.
Pembrey Faulk, Rd.
Wilmington, Del.

FREED, JACK R.
32 Matthew Rd., Brookside, Newark, Del.

FREYGANG, GUSTAV G.
Rohm & Haas Co.
Bristol, Pa.

FRICKE, HOWARD M., JR.
Keystone Plastics Co.
701 Paynter St.
Media, Pa.

FRITZ, CARROLL S.
Dentist's Supply Co. of New York
York, Pa.

FRY, JAMES H.
Dixie Cup Co.
Easton, Pa.

GABUZDA, GEORGE E.
1803 Bybrook Rd., Fairfax
Wilmington 3, Del.

GALL, W. MURRAY
Luserne Rubber Co.
Muirhead Ave.,
Trenton 7, N. J.

GARBER, JOHN F.
Rohm & Haas Co.
Box 219
Bristol, Pa.

GITTELMAN, DONALD H.
The Glidden Co.
3rd & Bern Sts.
Reading, Pa.

GLENN, GRAEFF W.
The West Co.
Phoenixville, Pa.

GOLDSMITH, EDWIN M.
Wynn Manufacturing Co.
7th & Green Sts.
Philadelphia 23, Pa.

GOODMAN, HENRY H., JR.
E. I. du Pont de Nemours & Co., Inc.
Polychemicals Dept.
Wilmington, Del.

GORE, WILBERT L.
R.F.D. #2, Papermill Rd.
Newark, Del.

GRAF, GEORGE L., JR.
242 Potomac Rd.
Fairfax
Wilmington, Del.

GRAVES, WILLIAM L.
20 Westburg
Garden City, N. Y.

GREEN, ALFRED J.
115 W. 39th St.
Wilmington, Del.

GREEN, JOHN
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Philadelphia 43, Pa.

GRIFFITH, JOHN F.
Firestone Plastics Co.
Box 690, Pottstown, Pa.

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502 Cranebrook Rd.
Wilmington 3, Del.

GRINTZ, JOSEPH
Davisville Rd. & Turnpike
Hatboro, Pa.

GUHL, H. C.
4665 Dartmoor Dr., Wilmington 3, Del.

HAINES, RAYMOND, JR.
H M S Associates, Inc.
1923 Fairview Ave., Willow Grove, Pa.

HAMLIN, CARL B.
2500 N. Sixth St., Harrisburg, Pa.

HANNOLD, JOHN R.
Welding Engineers, Inc.
Norristown, Pa.

HANSON, DOYCE B.
905 Liftwood Rd., Wilmington 3, Del.

HANTZ, B. F.
American Insulator Corp.
New Freedom, Pa.

HARP, HARRY J., JR.
The Rainville Co. of Pennsylvania
1440 Old York Rd., Abington, Pa.

HARRINGTON, JAMES P.
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HARRIS, HARRY M.
Welding Engineers, Inc.
Box 391, Norristown, Pa.

HAUCK, J. JOHN
H & R Industries
Route 2, Walnutport, Pa.

HAUGHT, JOHN W.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept.
Experimental Station 323 Bldg.
Wilmington, Del.

HAYES, WALTER A., JR.
26 Shoemaker La., Bridgeport R.D. #1, Pa.

HEFT, HAROLD B.
Commonwealth Pipe & Tubing, Inc.
125 S. 2nd St., Philadelphia 6, Pa.

HEINEMAN, CARL R.
Quaker Rubber Corp.
Comly & Milnor Sts., Philadelphia 24, Pa.

HEKKING, ANTONY M.
Watson-Stillman Co.
Roselle, N. J.

HILTNER, JAMES B.
Rohm & Haas Co.
Bristol, Pa.

HOBSON, CHARLES M., JR.
United States Gasket Co.
600 N. Tenth St., Camden, N. J.

HOFFMAN, ROBERT J.
AA Plastics Co., Inc.
Haddonfield Rd., Merchantville, N. J.
HOFFMAN, WILLIAM E.
528 Emmett Ave., Trenton, N. J.
HOLST, JAMES R.
513 King of Prussia Rd., Wayne, Pa.
HOMBURGER, FREDERICK R.
1307 Maple Ave., Lancaster, Pa.
HOOPES, JOSEPH M.
1213 Brandywine Blvd., Wilmington 3, Del.
HOPKINS, GEORGE H.
Jug Hollow Rd., Valley Forge, Pa.
HULL, JOHN L.
Hull-Standard Corp.
Abington, Pa.
HULL, LEWIS W.
Hull-Standard Corp.
Abington, Pa.
HULSE, WILLIAM F.
Geo. A. Rowley & Co., Inc.
937 N. Front St., Philadelphia, Pa.
HUNSICKER, FREDERICK P.
Westinghouse Electric Corp.
3001 Walnut St., Philadelphia 4, Pa.
HUNTER, ROBERT H.
Atlas Powder Co.
Wilmington 99, Del.
HURST, D. A.
Rohm & Haas Co.
Box 219, Bristol, Pa.
HUTCHINGS, ALLAN A.
F. J. Stokes Machine Co.
Philadelphia 20, Pa.
IRELAND, RONALD
F. J. Stokes Machine Co.
5500 Tabor Rd., Philadelphia 20, Pa.
JACKSON, JOHN A., JR.
John A. Jackson Co.
117 N. Montgomery St., Trenton 8, N. J.
JAMES, RALPH E., JR.
410 Lawrence Ave., Lincoln Park, Pa.
JOHNSON, JAMES B.
Lincar, Inc.
6400 State Rd., Philadelphia 35, Pa.
JOHNSON, WILMOTT W.
18 Bucknell Ave., Del Haven, R.D. #1,
Cape May, N. J.
KEARNEY, MATTHEW J., JR.
The Luzerne Rubber Co.
Muirhead Ave., Trenton 7, N. J.
KELLY, WILLIAM J.
United States Gasket Co.
602 N. Tenth St., Camden 1, N. J.
KEMPER, PAUL R.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept., Sales Service Lab.
Wilmington, Del.
KEMPER, WILLIAM H.
Carpenter Steel Co.
101 Barn St., Reading, Pa.
KISSILEFF, ADOLPH J.
202 Plaza Bldg., Glenside, Pa.
KLEHA, FRANCIS B.
2 Cranberry La., Levittown, Pa.
KLEIN, FREDERICK W., III
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KOCH, GEORGE W., JR.
10 E. Haddon Ave., Oaklyn, N. J.
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KRAUSEN, RALPH S.
214 Thornridge Dr., Levittown, Pa.
KUBICO, MICHAEL A.
E. I. duPont deNemours & Co., Inc.
Du Pont Bldg., Wilmington, Del.
KUHN, L. B.
Firestone Plastics Co.
Pottstown, Pa.
LAMB, JOHN J.
Radio Corp. of America
RCA Victor Div., Bldg. 7-2
Camden 2, N. J.
LAMBERT, JOHN H.
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LANGSDORF, BENJAMIN F. T.
Leeds & Northrup
4901 Stenton Ave., Philadelphia 44, Pa.
LAUCK, ALFRED W.
125 Redman Ave., Haddonfield, N. J.
LAY, JOHN L.
A. H. Wirz, Inc.
2300 W. Fourth St., Chester, Pa.
LECKY, HERBERT S.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept., Sales Section
10th & Market Sts., Wilmington 98, Del.
LEDER, CHESTER R.
Atlas Powder Co.
Wilmington 99, Del.
LEHR, JAMES C.
E. I. duPont deNemours & Co., Inc.
10th & Market Sts., Wilmington, Del.
LEVIN, ALLAN F.
Lamb Plastics, Inc.
239 N. Union St., Lambertville, N. J.
LEW, BAAK WAI
Atlas Powder Co.
Wilmington 99, Del.
LINDSAY, JAMES P.
Burrock Co., Plastics Div.
Second & Heckett Sts., Camden 3, N. J.
LINDVIG, PHILIP E.
E. I. duPont Experimental Station
Hy Clay, Del.

LINTON, W. HENRY, JR.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept., Experimental Sta.
Wilmington, Del.
LUDASCHER, W. C.
Beverly Rd., Eddington, Pa.
LYCKBERG, BERNDT K.
Firestone Plastics Co.
P.O. Box #690, Pottstown, Pa.
MACKESSY, RICHARD F.
112 Kennilworth Alden Pk.,
Philadelphia 44, Pa.
MAC NEIL, H. N.
Tes Co.
1468 York Rd., Abington, Pa.
MAIER, ROBERT E.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept.
Wilmington, Del.
MAINS, GERALD H.
Marshall Heights, Yorklyn, Del.
MAITER, ARTHUR E.
Leeds & Northrup Co
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725 Marshall Dr., West Chester, Pa.
MALINOWSKI, THEODORE P.
Atlas Powder Co.
Wilmington, Del.
MALMBERG, WILLIAM A.
2501 Swede St., Norristown, Pa.
MARKHOFF, CHARLES E.
1812 Hartel St., Philadelphia 11, Pa.
MARKWOOD, WILLIAM H., JR.
Hercules Powder Co.
Hercules Experimental Sta.
Wilmington, Del.
MARTIN, JOHN P.
Hercules Powder Co.
Wilmington, Del.
MC AFEE, DANIEL B.
128 Clover Hill La., Strafford, Pa.
MC CANN, CHARLES
Elco Corp.
M St. below Erie Ave., Philadelphia 24, Pa.
MC CORMICK, GEORGE C.
Acheson Dispersed Pigments Co.
2250 E. Ontario St., Philadelphia 34, Pa.
MC ELLIGOTT, EDWARD M.
The Borden Co., Chemical Div.
5000 Summerdale Ave.,
Philadelphia 24, Pa
MC GRAW, JOHN J.
513 D St., Kennett Square, Pa.
MC GREW, FRANK C.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept.
Wilmington, Del.
MC INTOSH, W. J.
The Borden Co., Chemical Div.
Durite Prods., Dept.
5000 Summerdale Ave, Philadelphia 24, Pa.
MILNES, RANDOLPH G.
303 Greenhill Rd., Willow Grove, Pa.
MONEYHON, ROBERT J.
405 Quigley Ave., Willow Grove 6, Pa.
MOORE, ROBERT L.
U. S. Asbestos
Div., Raybestos-Manhattan, Inc.
123 E. Stiegel, Manheim, Pa.
MOORE, WILLIAM L.
Vulcanized Rubber & Plastics Co.
Morrisville, Pa.
MOREHOUSE, LAURENCE C., JR.
607 Lincoln Terrace, Moorestown, N. J.
MORGAN, C. P.
Pelmore Laboratories, Inc.
401 Lafayette St., Newton, Pa.
MUCKENFUSS, THOMAS F.
Sinko Tool & Mfg. Co.
8 Tanner St., Haddonfield, N. J.
MURRAY, DONALD L.
Plastmur Corp.
Tulip & Palmer Sts., Philadelphia 25, Pa.
NARIGAN, HAROLD W.
531 Berwyn Rd., Morrisville, Pa.
NAST, LEO
P.O. Box 363, New Castle, Del.
NELLIS, ADIN A., JR.
Chemstraud Corp.
Decatur, Ala.
NIELSEN, GEORGE C.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept.
1616 Walnut—Rm. 100, Philadelphia, Pa.
NISSLE, WILLIAM N.
226 Woodlawn Rd.
Penn Square Village, Norristown, Pa.
NIXDORFF, FRANK S., JR.
Moldcraft Products, Inc.
1505 W. 41st St., Baltimore 11, Md.
NOVOTNY, ERNEST E.
1030 Washington La., Philadelphia 38, Pa.
NOWACZYK, JOHN
A. H. Wirz, Inc.
2300 W. Fourth St., Chester, Pa.
OGDEN, F. FAXON
Atlas Powder Co.
Wilmington, Del.
PATON, JOHN B.
1902 Shipley Rd., Wilmington 3, Del.
PHELPS, G. W.
410 E. Magnolia Dr., Morrisville, Pa.
POLLACK, ALBERT R.
131 Vermilion Dr., Levittown, Pa.

PRICE, JAMES E.
Simonds Abrasive Co.
Tacony & Fraly Sts., Philadelphia 37, Pa.
PSCHORR, FRANK E.
Ciba Company, Inc.
Kimberton, Pa.
PUNNETT, WILLIAM M.
Houghton Lab.
322 Brush St., Olean, N. Y.
RADEL, WILLIAM
The West Co., Inc.
Bridge St., Phoenixville, Pa.
RAFSTEDT, RICHARD E.
Esterbrook Pen Co.
Cooper St., Camden, N. J.
RAVEN, JOHN E.
903 A Park View Apts.,
Collingswood 6, N. J.
REEDY, WILLIAM T.
912 Blythe Ave., Drexel Hill, Pa.
REX, JAMES S.
Plastic Center, Inc.
228-230 N. 15th St., Philadelphia 2, Pa.
REYBOLD, WILLIAM U., JR.
2 & Adams Sts., Delaware City, Del.
RIPKEY, HARRY A.
The Richardson Co.
Post Office Bldg., Flourtown, Pa.
RIZZO, ALBERT
12 Miry Brook Rd., Hamilton Square, N. J.
ROBERTS, NELSON F.
Reichhold Chemicals, Inc.
64 & Walnut St., Philadelphia 39, Pa.
ROBERTSON, EUGENE N.
Rohm & Haas Co.
Bristol, Pa.
ROE, HARRY R.
111 Allmond Ave., Liftwood,
Wilmington, Del.
ROEDEL, MILTON J.
E. I. duPont deNemours & Co., Inc.
Rm 13066, duPont Bldg., Wilmington, Del.
ROSATO, DOMINICK V.
Roybestos Manhattan, Inc.
Manheim, Pa.
ROSENSON, JAY H.
University Club of Akron
105 Fir Hill, Akron, O.
ROSSER, CHARLES M.
28 Callendar La., Wallingford, Pa.
RUSSO, ROBERT
Circle F. Mfg. Co.
20 Prince St., Trenton, N. J.
SCALES, GEORGE M.
Ciba Co., Inc., Plastics Laboratory
Kimberton, Pa.
SCHACHT, REIMER
907 Ormond Ave., Drexel Hill, Pa.
SCHEIRER, THOMAS J.
Winner Manufacturing Co., Inc.
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SCHNEIDER, FREDERICK W.
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SCHOBERT, WM. B., JR.
2004 E. Tioga St., Philadelphia 34, Pa.
SCHULTZ, GEORGE W.
101 Valley Rd., Hatboro, Pa.
SCHUMACHER, ELMER F.
908 Berkley Rd., Westover Hills
Wilmington 6, Del.
SCHUTZ, FRANK C.
Welding Engineering, Inc.
Norristown, Pa.
SCHWAB, ERNEST G.
Bakelite Co.
117 S. 17th St., Philadelphia 3, Pa.
SEYMORE, RAYMOND B.
Loven Chemical of California
Newhall, Calif.
SHAW, MARTIN L., JR.
E. I. duPont deNemours & Co., Inc.
1616 Walnut St., Philadelphia 3, Pa.
SHEFFER, JAMES B., JR.
H. D. Justi & Sons, Inc.
32 & Spring Garden Sts.,
Philadelphia 4, Pa.
SHOEMAKER, CHESTER S.
Bakelite Co.
117 S. 17th St., Philadelphia, Pa.
SILLING, C. E., JR.
American Viscose Corp.
1617 Pennsylvania Blvd.,
Philadelphia 3, Pa.
SKELLY, JAMES T., JR.
Hercules Powder Co.
Delaware Trust Bldg., Wilmington, Del.
SKIDMORE, RICHARD H.
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SMITH, E. E.
537 County Line Rd., Radnor, Pa.
SMITH, FRED H.
1437 Robinhood Rd.,
Hintington Valley, Pa
SMITH, JOHN A.
Hull-Standard Corp.
1944 Woodward Ave., Abington, Pa.
SMITH, R. MOEN
Vulcanized Rubber & Plastics Co.
Morrisville, Bucks County, Pa.
SMITH, WALTER J.
Firestone Plastics Co.
P.O. Box #690, Pottstown, Pa.
SORENSEN, HAROLD
425 Charles La., Wynnewood, Pa.

PHILADELPHIA, PIONEER VALLEY

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1916 Race St., Philadelphia, Pa.
SPERBER, MEYER
Sperber Co.
3300 Frankford Ave., Philadelphia 34, Pa.
SPIKER, IRVIN E.
Sun Oil Co.
1608 Walnut St., Philadelphia 3, Pa.
STABLER, ROBERT E.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept.
Wilmington 98, Del.
STECCA, LT. EUGENE A.
2335 Mundale Ave., Dayton 10, O.
STEIN, SIDNEY J.
International Resistance Co.
401 N. Broad St., Philadelphia 8, Pa.
STEVENSON, HOWARD S.
P.O. Box 8109, Philadelphia 1, Pa.
STIEGLER, FREDERIC L.
National Vulcanized Fibre Co.
Newark, Del.
STOTT, HARRY S.
769 Redman Ave., Haddonfield, N. J.
STRAIN, DANIEL E.
1301 Talley Rd., Wilmington 3, Del.
STRAUSS, WILLIAM
Strauss Engineering Co.
4716 N. Second St., Philadelphia, Pa.
STREET, LOUIS F.
Welding Engineer, Inc.
Box 391, Norristown, Pa.
STRONG, RICHARD V. D.
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5930 Tabor Rd., Philadelphia 20, Pa.
SULLIVAN, JOSEPH T.
Papermill Rd., Huntingdon Valley, Pa.
SWAIN, ALVAN E.
603 Elm Terrace, Riverton, N. J.
SWEET, WILLIAM R.
137 Parkview Ave., Penndel, Pa.
SYKES, WALTER
Sand Rd., New Britain, Pa.
SZPILA, JEROME S.
Lamb Plastics, Inc.
239 N. Union St., Lambertville, N. J.
TAYLOR, JOHN S.
Murphy Rd., R.D. #2, Wilmington, Del.
TEAGARDEN, JOHN B.
E. I. duPont deNemours & Co., Inc.
Polychemical Dept.
Wilmington, Del.
THIELEN, ALBERT F., JR.
Philco Corp., Appliance Div.
C & Tioga Sts., Philadelphia 34, Pa.
THOMAS, CHARLES W.
4719 Longshore St., Philadelphia 35, Pa.
THOMAS, PAUL E.
E. I. duPont deNemours & Co., Inc.
Polychemicals Dept.
Wilmington, Del.
THOMPSON, WALLACE B., JR.
E. I. duPont deNemours & Co., Inc.
Polychemicals Sales Service
Chestnut Run, Wilmington, Del.
TILEY, RAYMOND A.
American Cyanamid Co.
Plastics & Resins Div.
Bound Brook, N. J.
TROMBETTA, BEN J.
Acheson Dispersed Pigments Co.
2250 E. Ontario St., Philadelphia 34, Pa.
TUPPER, FRANK H.
245 W. Franklin St., Morrisville, Pa.
ULLMAN, J. O.
E. I. duPont deNemours & Co., Inc.
Rm. #13066 duPont Bldg.
Wilmington 98, Del.
VARIE, HAMILTON
Stokes-Trenton, Inc.
150 Enterprise Ave., Trenton, N. J.
VAUGHAN, FRANCIS B.
E. I. duPont deNemours & Co., Inc.
Experimental Station
Wilmington, Del.
WAGNER, HAROLD A.
1138 Lehigh St., Easton, Pa.
WAGNER, V. S.
2173 Pennington Rd., Trenton, N. J.
WAKEFIELD, RICHARD E. B.
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Aldan, Clifton Heights P.O., Pa.
WALKER, KENNETH D., JR.
1196 Dermond Rd., Drexel Hill, Pa.
WALTERS, LINWOOD A.
135 Greenwood Ave., Jenkinstown, Pa.
WARGO, LEWIS L.
Moldcraft, Inc.
1505 W. 41 St., Baltimore 11, Md.
WARRINER, W. C.
Brook Valley Rd., Greenville, Del.
WEAVER, EBON P.
16 Alton Rd., Trenton 9, N. J.
WEGENER, FRANCIS A.
105 N. Brown St., Gloucester City, N. J.
WELCH, HENRY W.
Armstrong Cork Co.
Lancaster, Pa.
WELSH, DANIEL G.
Hercules Powder Co.
900 Market St., Wilmington 99, Del.
WETTY, R. ALVIN
S. A. Wetty & Sons, Inc.
Upper Lewis Rd., Royersford, Pa.
WETZEL, CLAYTON S.
115 Walnut Ave., Wayne, Pa.
WHITE, ALONZO, III
Wilmington Plastics, Inc.
810 S. Heald St., Wilmington, Del.
WHITE, QUENTIN M.
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WHITNER, GEORGE A.
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Foxchase, Philadelphia 11, Pa.
WILLIAMS, ROBERT J.
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Reading, Pa.
WILSON, G. C.
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WILSON, HARRY R.
335 Oak Rd., Glenside, Pa.
WINTERS, RALPH M., JR.
American Viscose Corp.
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Philadelphia 3, Pa.
WISMER, EARL B.
Frost Hollow Rd., Easton, Pa.
WISMER, HARVEY G., JR.
Easton Plastic Products Co.
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WULC, STANLEY S.
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WUNSCH, M. A.
212 Reading Ave., Oaklyn, N. J.
YARNALL, D. I.
Commercial Plastic & Supply Corp.
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2044 Brookdale Rd., Toledo 6, O.
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2018 Parkside Blvd., Toledo, O.
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3340 Island, Toledo 9, O.
FILLMORE, WILLIAM E.
3723 Edinborough, Toledo 6, O.
GOLDEN, HAROLD R.
Farnsworth Rd., Waterville, O.
GORDON, THEODORE H.
3008 Drummond, Toledo, O.
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1109 Shelly St., Maumee, O.
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Sterling Grinding Wheel Co.
P.O. Box 801, Tiffin, O.
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2034 Penn Rd., Toledo 7, O.
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3156 Byrne Rd., Toledo 14, O.
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Holland Engineering
7340 Dorr St., Toledo, O.
HOFMANN, V. E.
608 Winthrop St., Toledo 10, O.
HYLAND, JAMES W., JR.
614 Corey St., Maumee, O.
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2829 Glendale Ave., Toledo 14, O.
JOBST, CONRAD
4726 Far Hills, Toledo 13, O.
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3675 Jackman Rd., Toledo 10, O.
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2112 Sylvan Ave., Toledo 6, O.
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1531 Milan Rd., Sandusky, O.
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K. & M. Machine Co.
3128-40 Bellevue Rd., Toledo 6, O.
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K. & M. Machine Co.
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MATTIMOE, P. T.
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Beal, Carl L.—NY
Beall, Ross L.—SS
Bean, Denis P.—ONT
Bean, Roy E.—RO
Beasten, J. G.—PH
Beatty, Gordon W.—ONT
Beauchamp, Lyle L.—DET
Beaudoin, Armand J.—CA
Beaudry, Anthony P.—PV
Beaumont, John E.—ENE
Beaver, Harold F.—DET
Bebee, Francis H.—NY
Beck, George, Sr.—NWK
Beck, George H., Jr.—NWK
Beck, Hubert L.—CHI
Beck, John—NWK
Beck, Murray J.—NY
Beck, Ronald D.—DET
Becker, Augustus—RSM
Becker, Hugo G., Jr.—DET
Becker, Paul C.—UMW
Becker, Wayne M.—SC
Beckett, Brandt H.—CI
Beckford, Basil E.—CA
Beckman, Charles F.—CHI
Beckwith, R. W.—ENE
Becwar, R. A.—CHI
Bedard, Albert O.—SC
Bedard, Charles J., Sr.—RSM
Bedics, Michael A.—NY
Beekley, John S.—PH
Beekley, Nathan S., Jr.—CA
Beel, Paul—NWK
Been, Jerome L.—NWK
Beene, Jones C., III—SS
Begley, James J.—NY
Behney, Dale F.—CA
Beique, Charles—QUE
Belden, Byron B.—MV
Belk, Philip A.—PH
Bell, Joseph F.—CHI
Bell, Richard M.—NWK
Bellak, Jules—PH
Bellg, Charles M.—TO
Bellin, Fred—NY
Bellinger, Thomas P.—CI
Belmuth, Harold M.—NY
Belrose, Albert L.—DET
Belshaw, Albert—CA
Bemus, Richard D., Jr.—MV
Benander, Clifford N.—RSM
Bench, Robert R.—ST
Bendel, Herbert C.—CT
Bender, Byron W.—CHI
Benedict, Nelson E.—ENE
Benevento, Peter J.—NY
Benford, Samuel M.—NY
Benkoe, Erwin—NY
Bennett, Albert J.—ONT
Bennett, Geoffrey R.—TO
Bennett, Harry E.—CHI
Bennett, Herbert L.—PH
Bennett, Norman C.—CA
Bennett, Ronald—BUF
Bennett, Walter P.—SC
Benoit, Joseph E.—CT
Bent, John T.—RO
Bentley, Arthur E. W.—ONT
Bentley, Charles W.—WNE
Bentov, Itzhak—PV
Benzinger, James R.—BUF
Berensten, Richard F.—ENE
Beres, Charles—NWK
Berg, Stanley—NWP
Berger, Fred A.—CA
Berger, Howard P.—CA
Berger, Jack—PV
Berger, S. E.—BUF
Bergquist, Victor P.—NWK
Bergsteinsson, Ingolfur—SC
Beringer, C. J.—CHI
Berk, Edmund C.—ENE
Berke, Ralph N.—NY
Berkov, Alexander—SC
Berlekamp, Kenneth L.—TO
Berlyn, Gerald E.—PV
Bermas, Edward M.—NY
Bernard, James L.—TO
Bernard, Maurice J.—SS
Berndt, Carl W.—BUF
Bernhard, Lewis A., Jr.—CT
Bernhardt, Ernest C.—PH
Berry, Leland L.—NWP
Berry, Robert E.—NWP
Berry, William S.—ONT
Bertolamy, Bertram J.—NWK
Bertolet, E. C., Jr.—PH
Bertucci, Vito—NWK
Berutich, John M.—KI
Bescherer, Robert E.—WNE
Beshgetoor, Ray V.—PH
Besse, Arthur L., Jr.—ENE
Besserman, J.—NWK
Bettcher, Bruce H.—PNW
Betz, Charles O.—DET
Beyer, Carlton E.—DET
Beyer, Thomas C.—NY
Bezark, Richard S.—CHI
Bezat, Alexander G.—UMW
Bhide, G. R.—NS
Bialy, Michael—NY
Bice, Richard W.—MV
Bickford, Everett W.—WNE
Bickford, Warren—ENE
Bigelow, John H.—ONT
Biggers, W. E.—DET
Biggs, Howard E.—GG
Bihary, Coleman C.—CA
Biklen, Donald W.—NWK
Bilanin, Frank—NWK
Billings, John K.—PH
Bindman, Stanley—NY
Bingham, Oren R.—PH
Binkley, E.—ONT
Birckhead, Taylor A.—BW
Birdsall, Oscar—DET
Birger, Jordan—ENE
Birkmaier, Carl J.—NY
Birmingham, Wm. J.—WNE
Birney, Edward W.—NWK
Birzstein, Leo P.—NWK
Bischak, John—ENE
Bishop, Hugh R.—NY
Bishop, Richard B.—PV
Bishop, Thomas G.—CO
Biskup, John—NWK
Bistline, Merrill B.—NWK
Bitter, H. Calvin—WNE
Bitter, Jack T. F.—WNE
Bizon, Max J.—WNE
Bjorksten, Johan—CHI
Black, James M., Jr.—CHI
Black, Lowell A., Jr.—CI
Black, Peter B.—NY
Black, Richard G.—PI
Black, Seymour—WNE
Blackwell, A. L.—BUF
Blackwell, C. Shannon—UMW
Blackwell, L. D.—ST
Blackwell, Stanley—CHI
Blaine, Robert P.—CA
Blair, Donald H.—NWP
Blair, Richard R.—CA
Blake, Raymond S.—NWK
Blakely, Kenneth C.—ONT
Blakslee, Edward L.—CHI
Blanchard, Charles L.—WNE

Blanck, Andrew R.—NWK
Blatter, D. V.—NWK
Blau, Benjamin—RSM
Blauvelt, Fowler—BUF
Blinzler, Glenn F.—CHI
Blitz, Saul—NY
Blizard, J. R.—RO
Bloch, Jack—ENE
Block, Joseph—RSM
Blomstrand, John H.—UMW
Bloom, Abe—SC
Bloom, Edward S.—PH
Bloom, Leonard—NY
Bloom, Milton W.—ONT
Bloom, Robert I.—SC
Blossey, Helmut—DET
Blount, Clinton W.—DET
Bloxam, Samuel D. N.—ONT
Bloxsom, Dan E.—ST
Bloyer, Stanley F.—NWK
Blume, W. A.—DET
Blumenthal, Samuel E.—WNE
Bobalek, Edward G.—CA
Bock, Richard E.—WNE
Bodenstein, William—NY
Bodner, Seymour S.—NWK
Boebinger, Elbert J.—CI
Boehme, Laurence M.—KI
Boeke, Paul J.—KC
Boess, Erhardt J.—PH
Bogart, Robert M.—NWP
Boggs, H. D.—KC
Bogner, John J.—GG
Bohlen, James C.—NY
Bohrer, George P.—NY
Bohrer, John J.—PH
Boice, E. L.—CO
Boker, Samuel J.—NY
Bokor, John, Jr.—NWK
Boldt, Arthur S.—NWP
Boldt, Eldon D.—KC
Boles, James C.—ST
Bolson, Harry B.—NI
Bolstad, Esther—UMW
Bolstad, Luther—UMW
Bolten, John, Jr.—ENE
Bonanno, Joseph J.—NY
Bonanno, Joseph L.—NWK
Bonin, Arnold V.—UMW
Bonnell, Peter J.—NY
Bonnett, John C.—QUE
Bontemps, Carl W.—KC
Bonwit, Albert—NWK
Bonwitt, Gustave L.—NY
Booker, R. G.—UMW
Boon, Peter H.—ONT
Boosahda, Michael K.—PV
Booth, George M.—NWK
Booty, R. G.—CO
Boraz, Martin L.—SL
Borden, Herbert M.—RSM
Borden, W. H.—DET
Bordner, Lee T.—SC
Borgman, Howard W.—DET
Bornstein, L. F.—PH
Borries, Frederic A.—CO
Borro, Edward F.—BUF
Borro, Edward F., Jr.—CHI
Borsellino, Jack—NY
Borton, Charles A.—NY
Bostwick, Robert—NWK
Bottleman, Raymond R.—PV
Bouchard, Robert L.—BW
Bouchek, Dimitri—NS
Bouchoux, J. W.—CHI
Bourne, M. G., Jr.—PI
Bouse, Robert L.—PH
Bowen, Griffith—PH
Bowers, Glenn S.—SEO
Bowers, Victor S.—PH
Bowlin, Donald R.—TO
Bowman, William G.—SL
Boyd, Maurice C.—SS
Boyden, Howard C.—RSM
Boyden, Robert J.—PH
Boyer, Thurlow L.—CA
Boynton, R. D.—RSM
Bracken, William O.—PH
Bracy, Frank L., Jr.—WNE
Bradbury, Roy—NWK
Bradbury, Wm. B.—NWK
Braden, John G.—MV
Bradley, John E.—BUF
Bradshaw, W. R.—ST
Brady, Raymond E.—DET
Brager, Norman H.—NWK
Braham, William E.—SC
Brand, Frank C.—CHI
Brandes, Peter L.—BUF
Brandner, John D.—PH
Brandt, Herman W.—CHI
Brandt, Jens J.—UMW
Brandt, Lawrence—NY
Brandt, Robert W.—CHI
Brannan, R. E.—NWK
Bratton, Francis H.—MV
Braun, David H.—SS
Brazener, H. M.—MIL
Brecher, Irving—NY
Brecker, John P.—NWK
Breitbarth, Robert—ENE
Brekke, Donald C.—UMW
Brenchley, J. A.—QUE
Brennan, Bernard J.—NWK
Brenner, Walter—NY
Brensinger, Harry F.—NY
Breskin, Charles—NY
Breskman, Samuel—PH
Breslau, Alan J.—NY
Bretl, Martin F.—MIL
Brevoort, F. L., Jr.—PH
Bricker, Neil J.—PITTS
Brickman, Herman J.—NY
Bridgen, Clarence J.—CHI
Bridges, Russell B.—ONT
Brierley, Eric—MV
Briggs, George J.—ONT
Briggs, Kendal L.—NY
Brightman, George—NWK
Brilhart, Arnold—SC
Brill, Paul H.—SEO
Brister, Joseph E.—NY
Britt, John R.—BW
Britt, Norman G.—NY
Brittain, L. P., Jr.—NS
Britton, Earl S.—PV
Broadbent, D. Edward—NY
Broadbent, Raymond W.—CA
Broadwell, T. C.—DET
Brock, Raymond L.—CHI
Brockland, Eugene J.—SL
Brockschmidt, Kenneth H.—MIL
Brodner, Joseph F., Jr.—CHI
Brody, J. S.—NY
Broer, William F., Jr.—TO
Broeski, Edward F.—SC
Brogi, Peter—NY
Bronnenkant, Paul—BUF
Brook, John T.—DET
Brooks, B. E.—CA
Brooks, H. E.—WNE
Brooks, Richard E.—PH
Brooks, Walton F.—NWP
Brooks, William W.—UMW
Brophy, Robert B.—SC
Brosius, Robert W.—CHI
Brosman, W. J.—PH
Bross, Harold N.—NY
Brotz, Frank M.—MIL
Brotz, Ralph T.—MIL
Brotz, Roman C.—CHI
Broughton, Amos W., Jr.—NWK
Brower, V. P., Jr.—WNE
Brown, Barton C.—NWK
Brown, Benjamin F.—CHI
Brown, Bertram M.—RSM
Brown, Charles G.—PH
Brown, Edward C., Jr.—CA
Brown, Edward H., Jr.—ENE
Brown, Ernest B.—PH
Brown, Francis—UMW
Brown, Gaylord W.—DET
Brown, George F.—BUF
Brown, George F., Jr.—CT
Brown, George T.—CI
Brown, Gordon—NWK
Brown, Grant—SS
Brown, Grant S.—WNE
Brown, Henry A., Jr.—SS
Brown, John R., Jr.—KC
Brown, Lawrence S.—DET
Brown, Omar D.—UMW
Brown, Paul E.—MIL
Brown, R. M.—CHI
Brown, Robert G.—NY
Brown, Robert M.—RSM
Brown, T. Kenneth—BW
Brown, Werner C.—PH
Brown, William F.—CHI
Browne, J. Gerry—CA
Bruce, R. H.—RSM
Brucker, Milton—SC
Bruckman, Eric A.—NWK
Brueggen, A. J.—DET
Bruggemann, Walter H., Jr.—MIL
Brumbach, Robert E.—CA
Brummel, Herbert L.—NY
Brummer, Milton L.—CHI
Brunner, J. C.—WNE
Brust, Alvin W.—SL
Bruton, Ralph L.—ONT
Bryan, Albert—CHI
Bryans, Harvey M.—RO
Brydon, Thomas E.—PV
Bryzinsky, Henry E.—BUF
Bub, Leo J., Jr.—SL
Bubernak, Steve—PV
Buchanan, Harry W.—NY
Buchhoff, Leonard S.—PI
Buckel, George W.—RM
Buckman, Charles—CHI
Buecken, H. E.—CA
Buerosse, Alfred E.—MIL
Buffington, R. K.—SC
Bugbee, Philip D.—WNE
Buhlmann, Frank H.—MV
Buhr, Richard K.—ONT
Buike, Melvin L.—BUF
Bukey, J. Robert—PH
Bukowski, Albert E.—WNE
Bulkley, Charles W.—WNE
Bullock, Edgar O., Jr.—PH
Bunker, Robert F.—RO
Bunnell, Claude A.—PH
Bunner, Gale J.—RSM
Bunyan, John—NS
Burack, Elmer H.—CHI
Burger, John E.—CT
Burgess, H. R.—NY
Burian, Anthony—DET
Burk, Robert E.—PH
Burke, Joseph A.—KC
Burke, Robert E.—UMW
Burkhart, F. C.—SEO
Burkhart, M. W.—CO
Burkhart, Reginald K.—BW
Burkholder, Ward J.—ST
Burkinshaw, Lawrence D.—WNE
Burnett, James G.—NWK
Burnett, L. S.—CT
Burnie, John L.—ONT
Burniston, Harry W.—NWP
Burns, Joseph P.—KI
Burns, Robert T.—PH
Burpo, Howard L.—NWK
Burritt, Leonard—RO
Burt, Emanuel—SS
Burton, George F.—CI
Burton, Richard E.—PH
Bury, Paul A.—UMW
Busada, John K.—NY
Busch, John F.—CO
Busch, Richard D.—PH
Buschmann, Warren T.—SC
Bush, Arthur E.—UMW
Bush, Leon D.—CHI
Buss, Onno B.—CO
Bussart, Walter P.—SL
Buthmann, Edwin—ENE

Butler, Donald R.—CA
Butler, E. T.—PH
Butters, Frank D.—NI
Butzlaff, Harry R.—MIL
Buzicky, Elmer J.—UMW
Buzzee, Milo H., Jr.—KI
Buzzee, Robert D.—CHI
Bygrave, J. H.—ENE
Byrd, David C.—NWP
Byrd, William R.—NWP
Byrne, John R.—CHI

C

Caddell, William D.—CHI
Cadieux, Joseph H.—DET
Cagan, Bernard J.—SC
Cain, W. E.—CO
Caine, Martin G.—WNE
Cairns, Hugh—ONT
Calabro, Anthony D.—PH
Calandrello, Nicola A.—ENE
Caldwell, E. Davis—NWK
Caldwell, Morris—NY
Caldwell, Paul L.—MV
Calef, John F.—CHI
Calhoun, Leonidas M.—NY
Callahan, Edward W.—RSM
Callahan, Michael T.—NY
Callahan, Theodore A.—RO
Callery, George L.—PH
Calpin, Cyril J.—BI
Cameron, A. B.—RSM
Cameron, James L.—QUE
Campana, John T.—CA
Campbell, John B.—NY
Campbell, Robert H.—MV
Campbell, Thaddeus C.—NY
Campbell, William B.—PH
Campen, Richard N.—CA
Campi, A. Edward—CA
Canarios, Chris—CA
Canavan, William J.—NY
Canner, Leonard E.—TO
Canning, John L.—MIL
Cantor, Justin P.—CA
Cantor, Robert L.—NY
Caplan, Donald—CHI
Cappanera, A. R.—NS
Carbary, Gordon L.—DET
Carey, James E.—NWK
Carey, Robert H.—NWK
Carey, Thomas J.—ONT
Cargile, Neil H.—KI
Carhart, Randall O.—KI
Carley, James F.—NWK
Carlson, George W.—WNE
Carlson, Harold A.—CT
Carlson, Melvin J.—BW
Carlson, Robert B.—ENE
Carlyon, George C.—DET
Carmagnola, Ernest D.—NY
Carman, F. H.—BW
Caro, Leonard J.—NWK
Carolin, P. James—DET
Carpenter, Gilbert W.—MV
Carr, J. A.—ONT
Carr, Marvin E.—PNW
Carraher, James F.—CA
Carrico, Wayne K.—KI
Carson, William G.—PH
Carter, Charles H., Jr.—PH
Carter, David C.—CT
Carter, Eric W.—ONT
Carter, Nicholas—MV
Carter, Raymond H.—ENE
Carter, Robert B.—NWK
Caruso, Joseph N.—NWK
Cary, Cort F.—BUF
Caryl, Richard G.—NWP
Casey, James D.—ENE
Casey, John B.—ENE
Casey, Joseph F.—KI
Cashulette, Charles G.—MIL
Cassick, Albert B.—BUF
Cassidy, J. Clarke—BUF
Castelli, Charles—NWK
Catalde, Charles E.—BUF
Catalucci, Herman J.—PV
Cathcart, Eugene C.—RO
Caton, Jesse H.—RSM
Caunter, Earl G.—CA
Cauthery, B. R.—ONT
Cavender, James V., Jr.—ST
Cawrse, Llewellyn S.—CA
Cedwall, Jean—NS
Chabotte, Alfred M.—RSM
Chadfield, Robert W.—CHI
Chafetz, Morris H.—RSM
Chafetz, Samuel—PV
Chamberland, Roland E.—RSM
Chamberlin, E. E.—DET
Chambers, Dwight H.—UMW
Chambers, Ralph F.—SS
Chance, Walter R., Jr.—BW
Chaney, J. Ellis—RM
Chapman, John M.—QUE
Chapman, Ralph E.—DET
Chaput, Armand—QUE
Charboneau, Walter—RSM
Charles, Henry E.—NWK
Charlton, James A.—CO
Charlton, John R.—QUE
Charter, Kenneth F.—MIL
Chase, Constantine L.—WNE
Chase, Donald C.—CT
Chase, Raymond S.—BUF
Chase, Stanley M.—PH
Chaundy, Lester E.—PH
Cheely, George W.—CHI
Chellis, Leroy N.—BI
Chemerys, Walter L.—BUF
Cheney, A. J., Jr.—PH
Cheney, R. C.—PNW
Chernik, Alphonse J.—CT
Cherpelis, George—DET
Cherwin, Stanley G.—CHI
Chesick, Stanley F.—BI
Chew, Donald H.—PH
Child, Stanley G., Jr.—PH
Childs, Edmund S.—WNE
Chip, Joseph B.—NY
Chitwood, Charles W.—CI
Cholakis, John C.—WNE
Chollar, Robert G.—MV
Chomicz, John—SEO
Christensen, Delbert L.—CHI
Christensen, M. L.—SL
Christie, Douglas R.—ONT
Chrones, Charles—RSM
Chrostowski, Frank, Jr.—NWP
Church, James M.—NY
Church, James S.—NS
Chute, Frank E.—CO
Cirata, Metro—PI
Ciszewski, Alexander W.—WNE
Clackum, E. Glenn—PV
Clague, Robert H.—MIL
Clancy, Joseph F.—ENE
Clancy, Joseph P.—RSM
Clapp, Herbert H.—CI
Clare, George—NWK
Clare, Philip P.—NWK
Clark, C. A.—PH
Clark, C. Todd—SL
Clark, Francis A.—ONT
Clark, George W.—WNE
Clark, Herbert P.—ENE
Clark, Herbert R.—PH
Clark, John B.—CHI
Clark, Richard A.—CO
Clark, Robert C.—PH
Clark, Roland—TO
Clark, W. G.—WNE
Clark, Walter R.—KC
Clarke, Donald P.—ONT
Clarke, Edward V.—NY
Clarke, Kenneth G.—PHIL
Clarke, Robert C.—UMW
Clarke, William C., Jr.—PV
Clash, Donald F.—RSM
Clason, George F.—RSM
Cleavenger, Thomas H.—CHI
Clegg, Frederick L.—PV
Clemens, James—NY
Clement, Charles J.—ENE
Cleworth, C. William—CT
Clinker, William H.—GG
Clinton, James—BUF
Clough, Gerald C., Jr.—CA
Clout, E. A.—QUE
Cloyd, Harold S.—NWP
Coan, Prescott—WNE
Coburn, Clarence J.—ENE
Cocci, Amelio J.—PV
Cochran, Paul L.—SEO
Cochrane, Garnet—BUF
Cochrane, William D.—ENE
Coddington, E. Robert—CA
Coderre, Richard A.—NY
Coe, Clarence W.—WNE
Coffman, A. C.—CA
Cogdell, James F., Jr.—PH
Cohan, Gerald F.—CA
Cohen, Charles E.—NY
Cohen, Irvin M.—PH
Colby, H. C., Jr.—PH
Colby, Paul N.—CA
Cole, Alan S.—NY
Cole, Barton A.—PNW
Cole, Fred A.—DET
Cole, Gerard W.—CI
Cole, James M.—ONT
Cole, Morton S.—SC
Cole, Walter F., Jr.—RSM
Coleman, George H.—PI
Coleman, James J.—NWK
Coleman, Samuel D.—CT
Coleman, William E.—WNE
Collette, McKay—PH
Collins, Benjamin S.—NWK
Collins, Charles L.—DET
Collins, Donald E.—CI
Collins, Herbert B., Jr.—RO
Collins, H. Lewis—ST
Colson, Victor H.—UMW
Colvin, Henry F.—NWK
Colwell, Robert E.—WNE
Comeau, John E.—KC
Comer, Thomas C.—CHI
Commisso, Nicholas D.—RO
Comstock, Gilbert—NWP
Conaway, Paul—CHI
Condon, William F.—CA
Condon, William F.—NY
Cone, Leslie H.—BI
Confer, Raymond C.—BUF
Conklin, Benjamin F.—NY
Conklin, Charles S.—NWK
Conley, Douglas M.—ONT
Conley, Fred—DET
Connell, Frank A.—NWK
Connell, John J.—CI
Connelly, Lewis B.—ST
Conner, Gene A.—UMW
Conner, John R.—MV
Connor, Dick V.—NWP
Connors, Harry E., Jr.—ENE
Connors, James M.—CHI
Conroy, Martin E.—NWK
Conroy, Wm. C.—NWP
Consolloy, James W.—PH
Conway, Adrian L.—DET
Conwell, Robert P.—PH
Conwell, Yeates—PH
Coogle, K. L.—SS
Cook, Frank E.—PH
Cooke, Harold G., Jr.—KI
Cookingham, Howard C.—ENE
Cooley, W. Lemoyne—BUF
Coombs, Charles E.—WNE
Coombs, Robert B.—NY
Coons, B. M.—SL
Cooper, Edward B.—PH
Cooper, Harold D.—NY
Cooper, Thomas H.—RM
Cooper, Wallace R.—GG

Cooper, Warren F., Jr.—CHI
Cooper, William J.—BW
Cooper, Zeke—NY
Cooperman, Norman L.—NY
Cope, Dwight W.—SL
Copeland, Herman—NY
Copeland, James E.—CA
Copping, George A.—ONT
Coppola, Vincent G.—BI
Corbett, Harold—PV
Corbett Herbert O.—RO
Corbin, James R.—CHI
Cordier, David E.—TO
Corliss, Wayne—PV
Cormier, Raymond Z.—ENE
Cornell, Robert J.—NWK
Cornmesser, Donald E.—NWK
Corrigan, John R.—CA
Corrigan, Owen—KI
Corwin, James F.—MV
Corwin, John F.—PI
Cossette, Albert F.—NY
Costanza, Leonard J.—SC
Costello, Thomas C.—SC
Cotton, Charles J.—ENE
Cotton, Jordan L.—ENE
Coughlan, Ian L.—QUE
Coughlan, Joseph J.—PV
Coughlin, William J.—CT
Cougill, Charles E.—NI
Coull, Wallace W.—PH
Couperus, P. G.—PH
Courtney, J. Phillip—SC
Cousins, G. Wm.—ONT
Cowan, C. J.—RSM
Cowan, David D.—CHI
Cowden, John W.—ST
Cowles, Roderick J.—ENE
Cox, John M.—CI
Cox, John T., Jr.—BW
Cox, Vincent T.—ENE
Coyne, Robert J.—BI
Coz, Alfred L.—PV
Coz, Henry W.—PV
Craddock, Herbert—NS
Craig, Walter R.—PI
Crain, Donald J.—CI
Cramer, Donald—WNE
Cramer, Philip N.—NWK
Crandall, Fletcher—ENE
Crandell, William H.—ENE
Crandon, Harry D.—WNE
Crane, Edgar—CHI
Crane, James E.—PV
Crane, P. Willard—MV
Crater, Willard De C.—CT
Craver, Joseph N.—CHI
Crawford, Donald C.—KC
Crawford, Kenneth Z.—CI
Crawford, M. B., Jr.—SC
Crawford, Richard H.—RO
Crawford, Robert W.—WNE
Crawford, Sherman M.—CA
Crawford, Thomas W.—NWP
Crawford, William M.—SC
Creamer, Walter P.—PH
Creighton, Albert M., Jr.—ENE
Cressy, Kenneth D.—SC
Crew, Robert S.—NWP
Crocker, Zenas, III—NWK
Croft, George R.—SC
Croisant, E. H.—CHI
Croley, Leo B.—KC
Croll, William L.—CO
Cronin, Edward W.—PH
Cronin, Herbert T., Jr.—RSM
Crosby, Abner E.—NI
Crosby, Herbert C.—NI
Crosby, Josiah D.—ENE
Crosio, Enrico—NS
Crouch, Robert T.—NWK
Crowley, V. Thomas—SC
Crumbley, Leland J.—SC
Cruse, William T.—DET
Csaszar, Ernest J.—NWK
Cuddy, Samuel—RSM
Cuddy, Thomas—RSM
Cullinane, William F.—PI
Culp, Robert L.—DET
Culwick, Edward F.—PH
Cuming, William R.—ENE
Cummings, Arthur W.—NY
Cunha, George R.—ENE
Cunningham, Colin M.—ENE
Cuozzo, Angelo M.—NY
Currie, James E.—NWK
Curry, C. H.—KC
Curry, Francis P.—RO
Curtis, Frank M.—DET
Curtiss, Garry—CA
Cushing, James J.—ENE
Custer, George M.—BW
Cutroni, Frank J.—PV
Cutroni, Salvatore J.—PV
Cwynar, John W.—BI
Cyphers, H. W.—PH
Cyr, Rob Roy—SC
Czarnecki, Sigmund—PV
Czebatul, William A.—TO
Czerwinski, Emil—CT

D

Dabbs, J. S.—RO
Dague, Harold F.—SC
Daher, Albert P.—NWK
Dahl, Kenneth T.—CHI
Dahl, Nils J.—PV
Dahl, Robert B.—DET
Daidone, John—NY
Daignault, Alfred P.—MV
Dailacis, Arvids A.—SC
Dailey, Alton—RO
Dailey, Donald E.—KI
Dailey, Robert G.—DET
Dailey, Robert W.—NY
Dalton, Francis B.—DET
Daniels, Alan—NY
Daniels, David A.—ST
Daniels, Raymond E., Jr.—CHI
Danson, Barnett J.—ONT
Darby, Harry L.—PH
Darling, LeRoy A.—NY
Darlington, H. S.—PH
Darnell, George—NY
Darnell, William H.—PH
Darr, Harold W.—UMW
Dash, Harriman H.—NY
Dauphinais, George A.—PH
Davenport, Robert A.—TO
Davenport, Robert C.—ENE
Davey, Victor L.—ONT
David, John—UMW
David, Raymond C., Jr.—PV
David, Steven G.—BI
Davidson, Emil—NY
Davidson, Herbert—NY
Davidson, Jas. R.—KI
Davidson, Kenneth G.—QUE
Davidson, Morgan W.—KC
Davidson, R. T.—PNW
Davidson, Robert L.—MV
Davies, Thomas H.—BI
Davis, Charles C., Jr.—PH
Davis, Clinton E.—DET
Davis, Clyde W.—GG
Davis, Donald A.—KI
Davis, Elbert—SC
Davis, S. Gilbert—PV
Davis, George E.—PH
Davis, James L.—SL
Davis, John F.—NY
Davis, Leon I.—CI
Davis, Marvin W.—NY
Davis, Millard L.—KC
Davis, Morton—NWK
Davis, Norman R.—NY
Davis, Raymond G.—DET
Davis, R. L.—BW
Davis, Robert—ENE
Davis, Robert E.—CO
Davis, S. Gilbert—PV
Davis, Samuel R., Jr.—BW
Davis, Sanford—DET
Davis, W. J.—PH
Davis, Walter—NY
Dawn, Frederic S.—MIL
Day, Bess—CO
Day, Jesse H.—CO
Day, Lester E.—NWK
Day, William A., Sr.—NY
Deak, Louis, Jr.—DET
Dean, Lyle R.—SL
Dean, Robert D.—NWK
Dean, Ross H.—MIL
Dearle, Denis A.—WNE
De Bell, John M.—BW
De Bell, Richard S.—WNE
Debing, Lawrence M.—WNE
De Boo, Emil A.—CI
Debreceni, Theodore G.—CI
De Bree, F. William—NWK
De Brock, Robert F.—TO
De Brule, William J.—SS
De Camp, Wayne—CI
Deckel, Edmond B.—CA
Decker, Judson—DET
Decker, W. E.—NWK
Dedman, Noel—KI
Dee, Allerton—CHI
Deef, James W.—DET
Deeren, William R.—SEO
De Felice, Amedio—ENE
Degalan, William V., Jr.—DET
Degner, Carl O.—CHI
De Hamer, Janus R.—SS
Dehan, Edward C.—TO
De Han, William P.—TO
Dehmel, William G.—NY
De Hoff, George R., Jr.—PH
De Hoff, Ronald L.—NWK
Deitemeyer, Jerome A.—PV
Delaire, Gerard V.—RO
Delaney, James E., Jr.—PH
De Lay, Roy, Jr.—ST
De Leeuw, Bert J.—NWK
Del Favero, John—GG
Deli, Frank D.—CHI
Della Rocca, Ralph J.—NY
Dellheim, Adolph—NY
Delmonte, John—SC
Delmonte, Julian—SC
Delnevo, Fred—PH
De Lorme, George A.—NWK
Del Pesco, Andrew—RSM
Deluca, Michael F.—PV
Demarco, Thomas A.—WNE
Demarest, Millard—NWK
Demas, Peter—PV
De Matteo, Adolphe J.—NWK
De Mattia, Lawrence—NWK
Demers, Joseph T.—DET
Demmler, Frederick W.—MV
Demurjian, A. C.—RSM
Deney, Herman J.—BUF
Dennison, A. Vard—NWK
Dennison, David L.—PH
Denny, Mary G.—DET
Denny, Richard J.—DET
Denslow, Victor A.—CHI
Derham, Philip A.—PH
Dermody, William J.—PHIL
Derowski, Edward—PH
Derr, Richard N.—CA
De See, Peter G.—NWK
De Shazor, James C., Jr.—NS
Detwiler, E. B.—PI
Devies, Robert L.—CA
De Vietien, Max J.—CI
De Vito, Joseph G.—NY
Devor, Elmer—CHI
De Vore, Henry W.—NY
Dew, B. Jarvis—BI
Dewar, C. K.—QUE
Dewar, W. J.—SC
Deweese, Robert G.—RO
De Witt, William J., Jr.—RO

Deyle, Olin H.—RO
Diaddario, Alex N.—BUF
Diamond, Leo J.—WNE
Diamond, Maurice L.—NY
Dick, Franklin—NY
Dickman, Carl H.—BI
Dickerson, Stanley W.—NWK
Dickten, Erich—MIL
Di Donato, Albert M.—ENE
Di Donato, Louis—ENE
Dietz, Albert G. H.—ENE
Diggins, Bernard—SC
Di Giorgio, F. D.—BW
Dildilian, Ara T.—WNE
Dillion, Kenneth P.—CT
Dilthey, Albert D.—SL
Di Marzio, Pat—PV
Dimmer, Charles L.—TO
Dina, Don S.—GG
Dinges, Harold R.—KC
Dingman, Edward G.—BW
Dinion, Nathan—RO
Dinsch, Fred L.—CO
Dintiman, L. Lloyd—NY
Dinzl, Richard W.—NWK
Di Pierro, Domenic—PV
Dirstine, Philip H.—KC
Ditzel, Kenneth L.—BUF
Dixon, Lloyd A., Jr.—SC
Dixon, R. R.—CO
Dmythryshyn, Michael—RSM
Doane, Malcolm E.—NWK
Dobbs, Morris L.—PV
Dockstader, John G.—ENE
Dockum, John F., Jr.—KI
Dodds, William R.—PH
Dodge, Charles W. H.—WNE
Doerfler, Lou, Jr.—NWK
Doerr, Albert H.—DET
Doherty, John A.—ONT
Dohrwardt, John F.—DET
Dollinger, Jack H.—CA
Dollins, Vincent C.—KC
Dolnick, Arthur A.—SEO
Dombrow, Bernard A.—NWK
Donabedian, Samuel—DET
Donahoe, John K.—NS
Donaldson, Alan E.—KC
Donaldson, Ralph F.—SS
Donnel, Harold L.—SC
Donohue, Frank J.—WNE
Dooley, Frank C.—PV
Doolittle, Edward J.—CA
Doolittle, H. A.—CHI
Doolittle, Kent—SC
Dorman, A. R., Jr.—WNE
Dorman, Elliot N.—NY
Dornik, Peter, Jr.—CHI
Dorst, Richard W.—GG
Doti, James A.—KC
Douce, William C.—NY
Dougherty, Frank M.—CI
Doughty, Carl J.—KI
Doughty, George G.—CHI
Doughty, Robert L.—WNE
Douglas, Harry T.—NY
Dourlet, Ernest F.—DET
Douville, James J.—ENE
Dowd, D. F.—NWK
Dowling, Eugene J.—WNE
Downing, Kenneth D.—DET
Downs, Myron H.—NWK
Doyle, Ernest W.—RSM
Doyle, John J.—NWP
Doyle, Robert—KC
Dragonette, A. J.—NY
Draper, Tom—DET
Draudt, Donald A.—CA
Draudt, Herbert—CA
Drauz, Gerhard D.—NS
Drescher, Ernest E.—GG
Drew, Albert E.—MV
Drewes, Raymond G.—NWK
Drexler, John H., III—CA
Driemeyer, William G.—SL
Drinkwater, Thomas R.—CHI
Drum, Lewis F.—SS
Drury, Clayton M.—ONT
Dubenitz, M. G.—NWK
Dubman, Jack—NWK
Du Bois, J. Harry—NWK
Ducca, Frederick W.—NWK
Duda, Edward F.—WNE
Dudley, Howard S.—NY
Dudley, Ralph—NWP
Dudney, Thomas E.—NY
Duerr, Samuel A., Jr.—PI
Duffett, N. B.—CHI
Duffy, Francis V.—PV
Dugan, James T.—NY
Dukert, A. A.—PH
Dukes, Paul R.—TO
Dulick, Thomas L.—CI
Duman, Abraham—NWK
Dumas, E. F.—PI
Dunay, David R.—NY
Duncan, David L.—CHI
Dundore, D. D.—PH
Dunham, R. E.—TO
Dunlap, Ralph D.—WNE
Dunlap, William A.—DET
Dunlop, Richard D.—ST
Dunmyer, William J.—BUF
Dunn, Clarence—MV
Dunn, Howard J.—NWK
Dunn, James L.—WNE
Dunn, Peter J., Jr.—CHI
Dunn, William—QUE
Dunnican, Wm. J.—RSM
Dunwoody, James—NWP
Dupler, Paul E.—PI
Duprey, Charles E.—PV
Dupuis, Arthur V.—WNE
Durbeck, Edward A.—NY
Durham, Harold F.—CI
Durra, Joseph B.—CHI
Durst, Robert F.—NWK
Dush, William S.—WNE
Dutot, Henry E.—CA
Dutton, Frederick O.—PH
Dutzer, Michael J.—CHI
Duval, Raymond P.—SS
Dvorak, Charles J.—CHI
Dwight, Theodore W., Jr.—WNE
Dwyer, Joseph J.—ENE
Dwyre, George L.—MIL
Dyer, William J. H.—RSM
Dzinian, Raymond J.—WNE

E

Earley, James J.—PH
Earley, Paul J.—CA
Eastman, Warren O.—CT
Eaton, Douglas G.—CA
Eaton, John H.—CA
Ebbert, Alfred H.—CI
Ebenholtz, James E.—PV
Eber, Leonard K.—NWK
Ebner, Charles A.—CO
Eck, Franklin E.—CHI
Eckenbeck, Everett E., Jr.—CHI
Eckenbeck, Everett E., Sr.—CHI
Eckenrod, C. J.—ST
Eckman, Lee R.—CA
Eckstein, Arthur I.—PH
Edelston, Joseph—CHI
Edenbaum, Jesse—RSM
Eder, J. Fred—ST
Edgar, Evert—CT
Edgerton, D. R.—CHI
Edlis, Stefan T.—CI
Edmunds, Edmund J.—PH
Edmunds, W. Harold—PH
Edwards, David A.—CA
Edwards, George N.—SEO
Edwards, Hugh K.—SL
Edwards, Royden B.—NY
Eells, Donald E.—CHI
Eflin, Pascal J.—CI
Egan, Charles—MIL
Egensperger, William J.—MIL
Egg, Leon R.—NWK
Egolf, Charles B.—PH
Ehart, E. P.—NS
Ehlers, R. W.—ENE
Ehrhardt, J. H.—BUF
Eisele, Wallace C.—CI
Eisner, Gerald—NY
Ekstrom, Helmer N.—CT
Elder, Max E.—DET
Eliason, Sigurd A.—RSM
Elliott, George C., Jr.—NY
Elliott, Paul M.—CT
Elliott, Robert S.—GG
Elliott, Watson O.—NY
Ellis, Carlton M.—RSM
Ellis, John D.—CHI
Ellis, Robert C.—NWK
Ellner, Edwin—NY
Ellsworth, W. E.—CI
Elmasian, Solomon—RSM
Elterman, Daniel—NY
Elterman, Leonard L.—NY
Elterman, Walter—NY
Emery, Donald B.—BW
Emil, Sanford J.—NY
Emsig, Jack—NY
Emsig, Sidney—NY
Endres, George C.—NWK
Engelmeyer, Herbert—NY
Engl, Arthur A.—BUF
England, Waldo B.—RO
Engler, Harold—NWK
Engman, James C.—MIL
Ennis, Herbert E.—NY
Ennis, Raymond W.—DET
Entenman, Robert J.—CA
Epel, Joseph N.—DET
Epstein, George—SC
Epstein, Lawrence—KC
Erb, William B.—SS
Erdle, George F.—RO
Erickson, Lawrence E.—UMW
Erickson, Oscar E.—CHI
Erickson, Porter W.—BW
Erickson, R. Kenneth—UMW
Erickson, Victor T.—CT
Erikson, Erik E.—DET
Erley, Walter—CHI
Erlich, Victor L.—NY
Ernst, Arthur H.—NWK
Ernst, Richard T.—PH
Ernst, Robert—NS
Erskine, Paul A.—SC
Erwin, Kenneth A.—KI
Esak, Joseph—NY
Eshenaur, Roy E.—KI
Esposito, Pascal A.—NY
Esposito, Ralph P., III—CT
Esposito, Vincent J.—NY
Esposito, Vincent J., Jr.—NY
Estabrook, F. Reed, Jr.—ENE
Evans, Alan A.—NWK
Evans, Arthur D., Jr.—SL
Evans, Lester W.—NWP
Evans, Lloyd G.—RSM
Evans, Luther J.—CHI
Evans, Robert B.—ENE
Evans, William B.—CI
Evans, William D.—MV
Eveland, Joseph—DET
Everling, William W.—UMW
Ewing, Jarvis H.—ENE
Exner, William E.—CHI
Eyre, James L.—ONT
Eyres, R. P.—ONT

F

Faber, Elmer L.—TO
Faber, Leonard E.—GG
Fabricius, Karl—ONT
Fabry, Richard J.—CHI
Fackler, Marion B.—NS
Fairbanks, Orvis J.—SS
Falberg, Edward E.—CHI

Falk, Eskel, Jr.—BI
Falkin, Abraham J.—NY
Faloon, John E.—RSM
Famely, Max—NWK
Farewell, H. Elgin—ONT
Farinelli, James A.—PV
Farmer, Marjorie E.—SC
Farmer, William A.—PI
Farnam, Otis W.—BI
Farno, Glenn A.—SC
Farnstrom, Harry T.—NWP
Farrell, James B.—ONT
Farris, Joseph P.—ENE
Farrow, John G.—PI
Fasano, Nicholas V.—NY
Fate, M. A.—CA
Favre, Edmond—SC
Fawcett, William L.—KC
Fay, Bernard W.—DET
Fay, Donald M.—NY
Faycik, F. H.—NWK
Faycik, Frank J.—NWK
Fedak, Daniel W.—PH
Feddema, Edward C.—NWK
Federico, Albert—NY
Fehr, Robert F.—NWK
Fehr, Roy B., Jr.—PH
Fehrenbach, Ludwig K.—WNE
Fehrman, Robert D.—CA
Feid, Robert A.—CHI
Feiler, Lore E.—NWK
Felger, Maurice M.—NI
Fellows, Fred H.—NWK
Fellows, Robert K.—BI
Fels, Arthur M.—PH
Felsenthal, James G.—CHI
Felsher, Hal-Curtis—NY
Felt, Paul W.—UMW
Feltz, Charles J.—NWK
Ferdinand, Louis J.—CA
Ferguson, Douglas E.—ONT
Ferguson, James—CHI
Ferguson, Joe S.—CI
Ferguson, John Edward—KC
Ferland, Paul E.—WNE
Fernald, Gordon—KI
Ferrari, Edward—CT
Ferraro, James C.—DET
Ferree, Charles—BUF
Ferri, Gustave, Jr.—NWK
Ferris, James M., Jr.—RSM
Ferry, Robert S.—BUF
Feuchter, Robert—RSM
Feuer, Seymour S.—PH
Fey, Horace C.—BI
Fialkoff, Samuel—NY
Fiedler, John—MV
Fiedler, Otto E.—MV
Field, Charles R.—CHI
Field, George A.—CA
Field, John H., Jr.—CA
Fields, Charles M.—SEO
Fietz, K. E.—NWK
Filippelli, Richard F.—DET
Fillmore, William E.—TO
Fina, Joseph E.—SC
Fina, Paul E.—CHI
Finch, Harold B., Jr.—UMW
Finch, Robert L.—SC
Fine, F. L.—CHI
Fink, Miller H.—SL
Fink, Ralph H.—MV
Fink, Roy G.—CO
Fink, Warren R.—NWK
Finkel, Henry—QUE
Finley, Charles R.—MV
Finn, Carl S.—CHI
Finney, Edward E.—NY
Fischer, Andrew J.—CHI
Fischer, Arthur C.—MV
Fischer, John J.—PH
Fischer, Leo—NY
Fish, Robert L.—NS
Fisher, David—RO
Fisher, Earl E.—CO
Fisher, Edwin G.—NS
Fisher, Halsey R.—DET
Fisher, Harlan R.—CT
Fisher, Joseph R.—PI
Fisher, Kenneth A.—WNE
Fisher, Thomas—ONT
Fisherman, David W.—NY
Fishman, George U.—NY
Fishman, Louis—CHI
Fisler, Royal E.—SL
Fitts, John E.—SS
Fitzgerald, Arthur E.—MIL
Fitzgerald, Cornelius G.—DET
FitzGerald, James H.—ENE
Fitzgerald, Vernon R.—RO
Fitzgerald, William J.—PI
Fitzgerald, William P.—NWK
Fitzharris, Leo J.—NWK
Fitzpatrick, Edward—PH
Fitzpatrick, Edwin N.—CA
Flanagan, George W.—BW
Flannery, Malcolm G., Jr.—BUF
Fleck, John W.—CA
Fleck, Robert D.—PH
Fleming, Donald W.—PV
Fleming, Kenneth B.—DET
Fleming, Philip G.—KC
Fleming, Winthrop A.—PV
Flemming, I. F.—ONT
Fligor, Kermith K.—CA
Floren, Carl E.—CHI
Florentine, Frank P., Jr.—WNE
Flynn, James W.—NWK
Foderaro, Edward J.—BI
Fogerty, James P.—NWK
Fogg, Jack E.—RO
Foguth, Joseph J.—DET
Foier, Joseph—NY
Foley, James L.—DET
Foley, William E.—PH
Fong, Gim Pon—ENE
Fontenelli, John J.—NWK
Fontenello, Frank J.—NWK
Foote, Paul W.—KC
Forbes, Charles T.—SC
Forbes, H. J., Jr.—SS
Ford, E. G.—ONT
Ford, John—SC
Ford, Paul B.—CHI
Foris, Julius—NWK
Forman, Benjam G.—NY
Formo, Jerome L.—UMW
Forsberg, George—RSM
Forsberg, Richard P.—GG
Forst, Ernest—CHI
Forsyth, J. L.—CA
Fortier, Willard C.—SC
Fortner, C. P.—WNE
Fortney, Eugene F.—NWK
Fortune, Harry E.—KC
Fortune, Kenneth S.—QUE
Fosse, John S.—CHI
Foster, Avery E.—RSM
Foster, James L.—CA
Fournier, R. H.—WNE
Foust, Orville N.—ENE
Fowles, George A.—CA
Fox, Benjamin—PH
Fox, Cyril B., Jr.—CHI
Fox, Kenneth E.—CI
Fox, Robert J.—NWK
Foxman, David A.—NWK
Foytho, Paul H.—CT
Fraas, Herbert C.—CT
Fracalossy, Gerald—NWK
Frackowiak, A. J.—NWP
Frados, Joel—NY
Frakes, William—CA
Franchitto, Anthony R.—ENE
Francis, Richard J.—CO
Frank, Jack—DET
Frankel, P. H.—QUE
Frankenfeld, Hubert F.—CHI
Franklin, Bernard E.—BW
Franta, William A.—PH
Frazier, Russell L.—CT
Frazzoni, Dominic—SEO
Fredecker, Richard C.—CA
Fredrickson, Charles M.—CO
Fredrikson, Donald A—GG
Freeborn, George E.—ENE
Freed, Jack R.—PH
Freedman, Ely—SS
Freeman, Hans—CHI
Freeman, Iver G.—PV
Freeman, Iver J.—DET
Freeman, L. W.—WNE
Freifeld, M.—WNE
French, Lynwood H.—RSM
French, Morton R.—NY
Fresne, Donald C.—DET
Freuden, Nathan A.—WNE
Freutel, Heinrich F. J.—BW
Freyermuth, James R.—UMW
Freygang, Gustav G.—PH
Friberg, Theodore—CHI
Fribley, Earl F.—NI
Fricke, Howard M., Jr.—PH
Fried, Walter H.—WNE
Friedberg, Arthur A.—NY
Friedman, Harry J.—NY
Friedman, Jules—NY
Friedman, Robert N.—MV
Fries, Earl C.—RO
Frikken, Bert R.—KC
Frisch, Kurt C.—DET
Frischer, George K.—KC
Fritts, Roger—SC
Fritz, Carroll S.—PH
Froh, H. L.—DET
From, Charles A., Jr.—CHI
Fromm, Carl A., Jr.—CA
Fronda, Arthur J.—NWK
Frost, Norman F.—GG
Frutchey, Edgar—DET
Frutchey, Harold E.—NWK
Fry, James H.—PH
Fuchs, John, Jr.—NWK
Fuggiti, Henry A.—PH
Fukuda, Yozo—OSA
Fukumoto, Takeo—OSA
Fuller, Arthur J.—ONT
Fuller, Frank W.—UMW
Fuller, Jack G.—SC
Fuller, Max W.—NWP
Fulmer, Gary C.—CO
Fulton, Robert A.—PNW
Funk, William U.—CHI
Furholmen, Erick—CHI
Furlani, Walter—BI
Furman, L. J.—PV

G

Gabelhouse, E. B.—SC
Gabriel, Edmond—NY
Gabriel, Lester—NY
Gabuzda, George E.—PH
Gadberry, Howard M.—KC
Gadd, Henry A.—ONT
Gaffey, Thomas T.—GG
Gager, Robert F.—BUF
Gagnon, Albert F.—WNE
Gaines, Jay H.—CHI
Gale, Eugene E.—ONT
Galinat, Donald R.—WNE
Gall, W. Murray—PH
Gallagher, Ned D.—KC
Gammel, Walter A., Sr.—CHI
Gander, A. T.—SEO
Gans, Leo—NY
Garard, James H., Jr.—CO
Garber, John F.—PH
Gardner, Charles N.—BW
Gardner, James—PV
Gardner, LeRoy M.—PH
Gargolinski, Joseph—PV
Garloch, Edward L.—NWP
Garrison, David H., Jr.—NWK
Gartner, Frederick—NY
Gary, Prem—NY

Garza, Arnold T.—ST
Gath, Rudolph—NS
Gatto, Michael R.—NWK
Gay, Matthew J.—SL
Gazdik, Emil R.—DET
Gazan, George A.—DET
Gebauer, Werner—NWK
Geber, Walter—NY
Gebhard, Harry W.—CHI
Geiger, Harry R.—SC
Geiringer, Paul L.—NY
Geiss, Sidney C.—CA
George, Emanuel J.—BW
George, Harold H.—NWP
George, Nick—NY
Georgett, Emile W.—NWK
Geraghty, Thomas—CA
Gerber, Albert J.—SL
Gerdes, Edwin—MV
Gerdes, Robert—MV
Gerdes, William H.—MV
Gering, Herman—NWK
Gering, Larry—NWK
Gerlach, Foster F.—DET
Gerlach, R. M.—NWK
Germak, Joseph G.—BW
Gerolomo, Albert A.—PV
Gerow, Milo R.—NWK
Gerrie, Robert D.—ONT
Gerrow, W. F., Jr.—SS
Gerson, Melvin M.—DET
Gerstacker, Robert E.—CO
Gerten, Nicholas, Jr.—NWK
Gessell, John H.—NWK
Ge Wertz, Arthur L.—NY
Geyer, Carl J.—CO
Giaimo, Mario—NWK
Giammarino, Joseph E.—NY
Giannotta, Carmen R.—NWK
Gibson, Arch M.—CHI
Gibson, William S.—ENE
Gideon, William P.—KC
Gierzadowicz, Stanley—CT
Gieschi, Thomas L.—WNE
Giese, William—NWK
Giesler, Arthur E.—SC
Giffen, William M., Jr.—CA
Gifford, Maurice J.—DET
Gift, Robert A., Jr.—NWK
Gigax, Lester E.—CA
Gigliotti, Michael F. X.—WNE
Gilbert, Casper S.—NWK
Gilcher, R. P.—DET
Gildersleeve, C. C.—CA
Giles, Robert S.—MIL
Gilkeson, Earl E.—CHI
Gillin, George F.—RSM
Gillis, James C.—QUE
Gilman, Arthur—NY
Gilman, Charles M.—CT
Gilman, J. W.—PNW
Gilman, Lucius—NWK
Gilmore, Gerald D.—DET
Gilroy, Paul J.—BI
Giordano, Frank J.—DET
Girner, John M.—ST
Gits, Joseph A., Jr.—CHI
Gittelman, Donald H.—PH
Glass, William B.—BUF
Gleich, Irving J.—NY
Glen, John D.—ONT
Glenn, Graeff W.—PH
Glick, Sanford E.—SC
Glider, Sydney S.—NY
Glowzinski, Thomas J., Jr.—DET
Glutting, Harry, Jr.—CA
Gmelin, Elmer F.—RO
Gmitter, George T.—CA
Gnecco, Richard A.—WNE
Gobeille, W. P.—MIL
Gobstein, Saul—NY
Gochenour, Carl I.—BUF
Godfrey, George J.—PI
Goebel, Herbert C.—CT
Goeden, Herbert A.—MIL
Goepfert, George J.—MV
Goetz, Charles R.—PI
Goetz, Daniel A.—PI
Gogel, A. J.—TO
Goggin, W. C.—DET
Goldblum, K. B.—WNE
Golden, Harold R.—TO
Golding, Brage—CHI
Goldman, Stanley—NY
Goldmark, Herbert H.—NY
Goldrick, Richard M.—UMW
Goldrosen, David—PV
Goldrosen, Louis I.—PV
Goldsborough, Edward A.—NY
Goldsmith, Edwin M.—PH
Goldsworthy, W. Brandt—SC
Gollub, Frank—SL
Gooch, John E.—PNW
Gooderham, H. Stephen—ONT
Goodfellow, Daniel R.—CA
Gooding, Elizabeth J.—CA
Goodman, Henry H., Jr.—PH
Goodwin, P. M.—BW
Goosman, Robert J.—MV
Goral, Ernest—RO
Gordon, Albert—CA
Gordon, Carl H.—PV
Gordon, Everett R.—PV
Gordon, Joseph M.—NY
Gordon, Theodore H.—TO
Gore, Wilbert L.—PH
Gorenflo, Frank—NWP
Gorman, Seymour—DET
Gormley, William L.—NWK
Goshia, Oliver—DET
Gosnell, Charles N.—BW
Goss, Wyman—WNE
Gosselin, Harry E.—CT
Gossett, R. Kenneth—CHI
Gossling, Robert G.—MV
Gottlieb, Albert J.—ENE
Gottschalk, Karl—SL
Gottschalk, William H.—SC
Goulait, Fred R.—DET
Gould, George—NY
Gould, William—NWK
Gould, William S.—TO
Goulder, George V.—CA
Goulder, Richard J.—CA
Goulka, James—CHI
Gow, Thomas M.—CA
Gowder, William A.—NWK
Graae, Soren J. W.—CT
Grabowski, Joseph—RO
Grad, Peter P.—RSM
Graf, George L., Jr.—PH
Graff, Milton—NY
Grafton, Percy—WNE
Grafton, Sydney—WNE
Graham, Bertram A.—DET
Graham, Bertram E.—PV
Graham, Donald L.—DET
Graner, William R.—BW
Granger, William T.—NY
Granlund, Earl W.—SC
Grant, Dean L.—PNW
Grasley, Robert—SC
Graves, William C.—CI
Graves, William L.—PH
Gray, Basil P.—ST
Gray, F. E.—MV
Gray, George J.—MIL
Gray, Howard A.—WNE
Gray, Robert F.—CHI
Gray, Robert K.—MV
Greacen, Edmund—NY
Greco, Frank J.—NY
Gredell, Otto N.—KC
Green, Alfred J.—PH
Green, Cecil —ONT
Green, Floyd—SL
Green, John P.—PH
Green, Laurence R.—NWP
Green, Lawrence B.—SC
Green, William E.—CHI
Greene, Howard E.—NY
Greene, Samuel N.—RSM
Greenfield, Paul V.—DET
Greenhoe, Joseph A.—WNE
Greenhood, Henry W.—SC
Greenlaw, Robert J.—CT
Greenleaf, Robert A.—CA
Greenlee, Sylvan O.—MIL
Greenwald, Harry R.—CHI
Greenwood, Samuel H.—PH
Gregg, Harry H.—NWK
Gregg, Walter F.—CA
Gregor, John R.—TO
Greif, Lucien R.—NY
Greifelt, Gunther H.—TO
Grenci, Dominic—RO
Grenier, J. R.—BUF
Greninger, Elias G.—CT
Gress, George C.—DET
Grey, Charles S.—NY
Grier, Henri B.—CHI
Gries, Robert—NWK
Griess, Gerald A.—DET
Griff, Allan L.—NWK
Griffith, Dan S.—DET
Griffith, Henry E.—WNE
Griffith, John F.—PHIL
Griffith, Lloyd A.—GG
Griffith, Roland K.—SC
Grigsby, W. E.—PH
Grillo, Thomas—CI
Grinberg, Herbert P.—SC
Grimm, C. Loring—GG
Grinnell, William W.—DET
Grintz, Joseph—PH
Grippo, A. Gene—CT
Groff, Frazier—NWK
Groover, Walter R.—NWK
Gross, Kenneth—NY
Gross, Warren R.—CA
Grossberg, Arthur N.—RSM
Grossman, G. L.—DET
Grossman, Harold—SL
Grossman, Harold E.—KI
Grossman, Jack—SL
Grosso, Thomas J.—NWK
Grove, James N.—DET
Growley, James T.—NWK
Gruber, Frank J.—SS
Gryce, W. W.—NWK
Guarnaccia, David—WNE
Gudermuth, Clyde S.—SL
Guenther, Frederick O.—KI
Guerrant, William B.—SS
Guhl, H. C.—PH
Gunn, Damon M.—BW
Gunn, John M.—PNW
Gurdo, Anthony F.—NY
Gurtowski, John J.—BW
Gustafson, Lewis H.—WNE
Gutai, John A., Jr.—ENE
Gutman, Ira H.—WNE
Guyer, J. Walter—DET
Guzzetti, Alfred J.—NWK
Gwyn, J. E.—BI
Gysel, Henry J.—RO

H

Haas, Chris—DET
Haas, Frank E.—CA
Haas, M. S.—ENE
Haas, Paul C.—NI
Haaxma, Harry—DET
Hacker, Hy—SC
Hackim, George, Jr.—CA
Haddad, Eli A.—WNE
Hadden, L. I.—CHI
Hadland, Richard A.—UMW
Hadley, Frank E.—UMW
Haenle, John, Jr.—DET
Haffling, Eric L.—CT
Hafner, Hans—WNE
Haggerty, James—NWK
Haines, D. W.—CO
Haines, Raymond, Jr.—PH

Halberstadt, L. James—WNE
Halbig, Joseph W.—KI
Hall, G. Lester—NWK
Hall, James F., Jr.—CHI
Hall, Keith W.—TO
Hall, Norman D.—ONT
Hall, Samuel—NY
Hale, George M.—QUE
Haller, Carl—NY
Haller, Walter C.—NY
Halliday, Kenneth C., Jr.—NWK
Halpern, Sigmund H.—NY
Halpern, Sol—NY
Halvorsen, Henry J.—NWK
Halvorsen, John J.—NY
Halward, Folke—DET
Hamamjian, A. George—NWK
Hambleton, Howard—KC
Hamel, Lewis E.—RO
Hamilton, Arthur C.—ONT
Hamilton, Donald A.—SC
Hamilton, T. M.—CT
Hamlin, Carl B.—PH
Hamlin, Charles E.—WNE
Hamlin, Horace C.—MV
Hammer, Ralph E.—WNE
Hammond, Roger H.—NWK
Hamner, Clyde J., Jr.—DET
Hancock, David—UMW
Hanger, Randolph T.—PNW
Hankey, Ernest H.—WNE
Hankin, Andrew A.—NWK
Hanks, Marshall W.—UMW
Hanley, Albert J.—ENE
Hanna, Russell D.—CHI
Hannaford, Vern L.—CHI
Hanninen, Urho E.—BW
Hannold, John R.—PH
Hansford, Van Buren N.—RO
Hansen, John A.—DET
Hansen, Otto—SC
Hansen, R. Dewey—DET
Hanson, Doyce B.—PH
Hanson, Ernest R.—NWK
Hanson, Hans R.—DET
Hanson, L. Frank—WNE
Hanson, Stanley J.—DET
Hanson, Victor E.—UMW
Hanszen, E. W.—ST
Hantz, B. F.—PH
Harban, Arthur A.—CHI
Hard, Herbert G., Jr.—SS
Hardeman, Thomas R.—MIL
Hardesty, Richard H., III—NY
Harmon, Richard E.—BW
Harp, Harry J., Jr.—PH
Harper, C. A.—BW
Harris, Albert H.—CA
Harris, E. E.—SEO
Harris, Frank—UMW
Harris, Harry M.—PH
Harris, Norman A.—SS
Harris, Ray H.—UMW
Harris, Zachary N.—SC
Harrington, James P.—PH
Harrison, Ralph F.—ONT
Harrod, Stuart L.—ENE
Hart, James R.—TO
Hart, Robert A., Jr.—SC
Hart, Thomas H.—SS
Hart, William A.—CHI
Hartkopf, Rudolph—TO
Hartle, Richard H.—NWK
Hartley, Donald O.—MV
Hartman, Joseph V.—CA
Hartmuller, Roger L.—NWK
Hartung, Harold—PI
Hartzell, Edson K.—RM
Harvey, Charles K., Jr.—CA
Harvey, S. T.—CI
Harwood, M. G.—NWK
Hase, Leopold—NY
Hazenzahl, Herbert E.—WNE
Haskins, Edward J.—CA
Hasler, Victor E.—SC
Hass, Alvin A.—NWK
Hastings, Norry M.—SC
Hatfield, A. L.—CHI
Hauck, J. John—PH
Haught, John W.—PH
Haugsrud, John L.—NI
Hauprich, Victor—SC
Hausmann, George J.—MV
Hawes, F. Lee—SL
Hawes, Richard S, III—SL
Hawk, David C.—RSM
Hawley, Clifford H.—WNE
Hawley, John W.—NI
Hawthorne, Andrew T.—BW
Hayes, Ralph F.—NWK
Hayes, Richard L.—RO
Hayes, Walter A., Jr.—PH
Haynes, Thomas J.—BW
Hayslip, George A.—RO
Hazneci, Nami—DET
Healey, Joseph P.—BUF
Hearn, Fred R.—SL
Hearons, James S.—MIL
Heath, William G.—NS
Hebert, Maurice G.—RSM
Hecht, Marco—RO
Heck, E. R.—CHI
Heckel, John T., Jr.—CI
Hedges, Ralph C.—KC
Hedgewick, Peter—ONT
Heenan, S. A.—CHI
Heffernan, Edwin W.—ENE
Heflin, George W., Jr.—KC
Heft, Harold B.—PH
Heidenreich, Frank W.—PI
Heil, Carl E.—CA
Heineman, Carl R.—PH
Heintz, Clifford E.—BUF
Heiser, John R.—CA
Hekking, Anthony M.—NWK
Helander, Frank G.—NWK
Heldmann, Henry J.—ONT
Heldrich, Gerard C.—NY
Helgesen, John A.—MV
Heller, Herbert—NY
Heller, Homer K.—BW
Hellinger, F. Karl—BW
Helliwell, S. Stewart—CHI
Hellman, Carl N.—NY
Helmrich, Charles W., Jr.—CA
Helwich, Louis A.—NY
Hemming, Harold—ENE
Henderson, Bradford J.—ONT
Henderson, E. R.—ST
Henderson, Horace S.—ST
Henderson, John C. N.—BUF
Henkel, Fred—DET
Hennessy, Leroy J.—BW
Henning, Alfred H.—ENE
Henning, James L.—CHI
Henry, Charles C.—CHI
Henry, Charles E.—CA
Henry, John E.—CO
Hensic, George H.—SL
Henson, Robert T.—SS
Herbert, Joseph M.—CA
Herbst, Austin H.—SC
Herbst, Clarence A.—CHI
Herez, Philip D.—CT
Herlihy, Sylvester D.—NY
Hermach, George R.—PNW
Herman, Philip B.—UMW
Hermonat, William A.—DET
Hernley, Chris R.—PI
Herot, Frederick C.—CA
Herrera, David E.—CHI
Herrick, Charles H.—MIL
Herring, John A.—NWK
Herring, Lawrence M.—NWP
Herrington, Robert W.—SC
Herrmann, John F.—NY
Hershey, Robert M.—CA
Herzina, Michael—DET
Herzog, Armin M.—SL
Herzog, Max L.—NS
Hess, Paul J.—SEO
Hess, Robert S.—ENE
Hess, William L.—SC
Heston, Eugene E.—CA
Hetler, Harry E.—DET
Heubaum, Ulrich—NY
Hewat, William M.—ONT
Heyser, Alton S.—BW
Heytmeyer, Herman R.—NWK
Hickey, Dale E.—CI
Hickey, Eric C.—ONT
Hickler, Walter R.—ENE
Hicks, Darrell D.—KI
Hicks, John F.—CHI
Hicks, William T.—NWK
Hickson, Charles H.—ENE
Hidding, Walter E.—CHI
Higgins, Dale G.—NY
Higginson, Bernard—KI
Higginson, Harley H.—KI
Hill, Carl L.—SC
Hill, Ernest J.—CA
Hill, George R.—PV
Hill, Howard J., Jr.—RO
Hill, James F.—NWK
Hill, John, Jr.—ENE
Hill, Merton E.—CHI
Hill, Robert F.—WNE
Hill, William J.—GG
Hill, W. M.—ONT
Hillegass, Alvin L.—SEO
Hiller, Robert L.—CHI
Hiller, R. L.—MIL
Hillier, Edward L.—CA
Hillsdon, Harold—ONT
Hilrich, Max—NY
Hiltbrant, Stephen D., Jr.—CA
Hiltner, James B.—PH
Hinaman, Ralph L.—CO
Hinchsliff, William E.—CHI
Hines, Joseph—WNE
Hinkhouse, W. D.—QUE
Hinkley, Howard W.—PV
Hirsch, David—NY
Hirsch, Irwin A.—SC
Hirschorn, Gerard W.—UMW
Hirtz, Walter E.—NY
Hitchcock, Arthur B.—CI
Hitchcock, Lyman H.—KI
Hitchins, Albert H., Jr.—WNE
Hitov, Joseph J.—BW
Hittle, R. E.—CI
Hixon, Emmett E.—DET
Hiza, Michael J., Jr.—RM
Hlavac, Charles R.—CHI
Hoadley, Franklin R., Jr.—CA
Hoag, James—SEO
Hobson, Charles M., Jr.—PH
Hobson, E. L.—WNE
Hochman, George—NWK
Hodges, James C.—BW
Hodges, William C.—GG
Hoehn, Robert H.—NWK
Hoeltzel, John L.—DET
Hoelzer, Russell L.—CA
Hoey, W. B.—DET
Hoffer, Robert A.—CHI
Hoffman, Donald F.—DET
Hoffman, John J.—DET
Hoffman, L. Earl—CHI
Hoffman, Milton S.—NY
Hoffman, Robert J.—PH
Hoffman, William E.—PH
Hoffman, William P.—DET
Hofmann, Martin G.—SS
Hofmann, V. E.—TO
Hogan, F. B.—WNE
Hogenson, William, Jr.—NY
Hojnowski, Stanley—NY
Holbrook, G. C.—PI
Holdsworth, Robert S.—ENE
Holladay, Harry P.—MV
Holland, Charles J.—CHI
Holland, Christian V.—CHI
Holland, Kenneth M.—GG
Holland, Marvin—CHI
Holland, William E.—NWK
Holleman, Oscar E.—WNE
Holmberg, Paul M.—WNE
Holmes, Carl E.—NY

Holmes, Laurence R.—DET
Holmes, Stewart W.—WNE
Holmes, Walter D.—PI
Holran, Paul D.—NWK
Holst, James R.—PH
Holstein, Alex, Jr.—RO
Holt, John E.—RSM
Holtz, Robert T.—CA
Holz, Harold A.—SL
Holzl, Albert B.—NWK
Homburger, Frederick R.—PH
Homeyer, Roger H.—BUF
Homma, Keiichiro—OSA
Honish, John K.—NWK
Honn, Francis J.—NWK
Hooper, John M.—PNW
Hoopes, Joseph M.—PH
Hoover, Clyde F.—NY
Hopfeld, Henry—GG
Hopkins, George H.—PH
Hopkins, Robert A.—CHI
Hoy, Harold L.—NWK
Hopper, Paul F.—BW
Horback, Stephen—NWK
Hornick, M. M.—NWK
Hornickel, Robert R.—PI
Horsefield, R. E.—ENE
Horton, Earl C.—NS
Horvath, Joseph—CT
Hosek, W. F.—CHI
Hough, Richard J.—SC
Houghton, Russell M.—BUF
Houle, Robert F.—ENE
Houle, Roger —QUE
House, L. S.—DET
Houston, John C.—PI
Houston, Roger A.—MV
Hovey, Almon G.—CT
Hovey, Victor M.—ENE
Howald, John—NWK
Howard, Clinton B.—ST
Howard, Elmer E.—BUF
Howard, Harold D.—SC
Howard, Hazen—PV
Howard, John B.—NWK
Howard, Thomas H.—MV
Howe, Vernon M.—RO
Howell, George H.—DET
Howell, William J., Jr.—NY
Howie, John Lloyd, Jr.—CHI
Hoyle, Tonnie A.—CA
Hronek, John F.—NWK
Huang, George C.—NWK
Hubbard, Robert A.—NWK
Huber, Louis—NWP
Huber, Richard L.—CA
Huck, Donald H.—NWP
Hudgens, Samuel K.—SS
Huebschman, George J., Jr.—BW
Huff, L. Maxwell—BI
Huggins, Eric H.—ONT
Hughes, Kent H.—CHI
Hughes, Orson G., Jr.—SC
Hughes, Robert L.—KC
Huidekoper, Prescott F.—NWK
Huisman, George R.—SC
Hulbert, Edwin F., Jr.—MIL
Hull, John L.—PH
Hull, Lewis, W.—PH
Hull, R. W.—NI
Hulse, George E.—KC
Hulse, William F.—PH
Hulterstrum, Harold D.—MIL
Hultgren, Arnold P.—CHI
Hultgren, Orville A.—UMW
Hultstrand, Winston R.—UMW
Hume, David R.—NY
Hume, Donald E.—SS
Humfeld, George P.—CI
Humphrey, G. Palmer—NY
Humphrey, Howard L.—MV
Hunsicker, Frederick P.—PH
Hunt, John R.—SS
Hunt, Wilber G.—SC
Hunter, Leland R.—PI
Hunter, Robert H.—PH
Hunter, William A.—NWK
Huntley, Lewis W.—ENE
Huntzicker, George F.—DET
Hupfel, Walter M.—ENE
Hurst, D. A.—PH
Hurwitz, Joseph M.—NY
Hussey, Carlyle J.—SC
Husted, Harry R.—DET
Hutcheon, Charles F.—NY
Hutchings, Allan A.—PH
Hutchings, Joseph L.—NWK
Hutt, Martin C.—CA
Hutton, Harry W.—ONT
Hutton-Miller, W. E.—NS
Huycke, Graeme—ONT
Hydrean, Peter—NY
Hyland, James W., Jr.—TO
Hyman, Joseph B.—NWK

I

Iasillo, Phil—NY
Igeler, Harold J.—SL
Ilfeld, Robert—DET
Ilkka, Gust A.—DET
Imig, Charles S.—KC
Ingersoll, T. W.—UMW
Ingham, Philip H.—NWK
Ingram, John T., Jr.—ENE
Inman, Norman W.—SC
Ireland, Ronald—PH
Irons, Kenneth H.—CA
Isenburg, Orville E.—CA
Isleifson, Robert E.—UMW
Ives, Frank—PNW

J

Jackameit, Wm.—NWK
Jackson, Anton—NY
Jackson, Boris A.—NY
Jackson, Dale E.—KC
Jackson, John A., Jr.—PH
Jacob, Richard J.—DET
Jacobs, Arthur S.—NY
Jacobs, Henry G.—NY
Jacobs, J. Earl—BW
Jacobs, Keith S.—CO
Jacobsen, Niels—NS
Jacobson, Bernard—DET
Jacobson, Carl H.—NS
Jacobson, Walter E.—CO
Jacoby, Joseph F.—SS
Jaffe, Maurice H.—PV
Jakubowicz, Frank J.—PV
James, Harlan A., Jr.—ST
James, James T., Jr.—ONT
James, Ralph E., Jr.—PH
Jamison, William C.—SC
Janson, Jan- Erik—NS
Jansons, Jelte—BW
Jarmon, Robert L., Jr.—ST
Jarrow, Stanley L.—CHI
Jarvey, William A.—UMW
Jarvis, Lactance A.—CHI
Jaskot, Edwin S.—NWK
Jasper, Cletus L.—CHI
Javitz, Alex E.—NY
Javkin, Simon—NY
Jaycox, Willard R.—WNE
Jean, Maurice A.—KC
Jeffery, Reuben, Jr.—CT
Jehl, J. C.—NI
Jehle, Joseph F.—NY
Jenest, Charles H.—ENE
Jenkins, Stuart M.—PNW
Jenks, George V.—KI
Jennings, Garland B.—CA
Jensen, Arthur H.—NY
Jensen, Eli—SEO
Jensen, Paul M.—DET
Jensen, Warren P.—PNW
Jepson, Carl H.—PH
Jereau, Robert N.—KI
Jerothe, Rudolph A.—NWK
Jex, Horatio N.—TO
Jindrich, Ralph W.—CHI
Jobst, Conrad—TO
Jocelyn, Douglas—DET
Johannes, E. Gent—SL
Johansen, Hans A.—CA
Johansen, Torkil G.—NY
John, Frederick W.—CHI
Johnson, Alden V.—NWK
Johnson, Algot W.—WNE
Johnson, Arthur C., Jr.—ENE
Johnson, Bernard T.—ONT
Johnson, Carl R.—WNE
Johnson, Dennis—NY
Johnson, Douglas L.—UMW
Johnson, Edwin W., Jr.—SC
Johnson, Emil H.—CT
Johnson, Gordon P.—PV
Johnson, James B.—PH
Johnson, J. Robert—RSM
Johnson, Kenneth C.—KC
Johnson, Lennart I.—UMW
Johnson, Leonard S.—UMW
Johnson, Marvin G.—UMW
Johnson, Phillip I.—CA
Johnson, Ray D.—UMW
Johnson, Richard A.—NWK
Johnson, Robert T.—KI
Johnson, Roy V.—CHI
Johnson, Spencer—NWK
Johnson Walter T.—BW
Johnson, Willard J.—NY
Johnson, Wilmott W.—PH
Johnston, George A.—TO
Johnston, Jack F., Jr.—PNW
Johnston, James E.—CHI
Johnston, Robert E.—CI
Jonah, Wilford B.—QUE
Joline, M. Arthur—NWK
Jones, David A.—NWK
Jones, Edward F.—NY
Jones, Harrison, Jr.—CI
Jones, James R., Jr.—CA
Jones, John R.—CHI
Jones, Joseph H.—MV
Jones, Paul A.—DET
Jones, Philip B.—RSM
Jones, R. Vernon—KC
Jones, Robert D.—SS
Jordan, Clarence A.—NWP
Jordan, Clifford—NWK
Jordan, Manuel A.—ENE
Jordan, Russell C.—NWK
Jordan, Walter E.—CHI
Joseph, Donald M.—NY
Joyce, Joseph A.—NY
Judge, Philip S.—NWK
Jung, William T.—DET
Junkin, Newton R.—DET
Jupa, Julius A.—NWK
Jupen, Arne V.—CT
Juredine, Gordon M.—CA
Jurgensen, Delbert F.—NY
Juve, Richard H.—CA

K

Kacalieff, Chris—SL
Kadin, Stanley S.—NY
Kadlec, Walter—SC
Kafer, Clare H.—DET
Kafka, Frederick M.—NY
Kahn, Richard P.—ENE
Kairath, Howard G.—NY
Kalaher, Miles J.—DET
Kalarian, Zareh S.—RSM
Kalde, Harold I.—SL
Kaley, Dudley—NY
Kaliner, Howard—DET
Kamins, Martin—ONT
Kaminsky, Philip F.—NY
Kanarvogel, Leon—NY
Kane, Joseph L.—NWK
Kann, Robert R.—CHI
Kaplan, Benjamin B.—NY
Kappel, Henry C.—CHI
Karas, Felix C.—SC
Karch, Herbert S.—CA
Karels, Charles—CHI
Karels, Thomas R.—CHI

Karmel, Leonard—NY
Karnes, John C.—BUF
Karns, R. W.—CHI
Karshner, Charles P.—CO
Kasch, Henry J., Jr.—MV
Kasch, Martin J.—MV
Kasha, Edwin E.—PI
Kasischke, Robert S.—CHI
Kassay, Andrew W.—TO
Kast, Harold L.—NWK
Katus, G. A.—RO
Katz, Abraham M.—NY
Katz, Irving—SC
Kaufman, Albert A.—NWK
Kaufman, K. A.—KC
Kaufman, Stephen M.—SC
Kavanagh, Harold A.—ENE
Kavanagh, J. A.—PV
Kayser, Emil J.—RO
Kazimier, Henry A.—CHI
Kazimier, J. C.—CHI
Kearney, Christopher E.—BI
Kearney, Matthew J., Jr.—PH
Kearns, James W., Jr.—NY
Keck, William R.—DET
Kee, T. E.—NS
Keegan, Robert B.—CA
Keeler, Gordon F.—CA
Keeley, John H.—CHI
Keenan, John D.—ONT
Kehl, Clarence—SEO
Kehoe, Harold E.—SC
Kelch, Alfred H., Jr.—MIL
Kellam, Barney—ONT
Keller, Kenneth M.—CA
Keller, Leon B.—SC
Keller, Theo. W.—NS
Kelley, Frank E.—NWK
Kelley, Frank M.—CT
Kelley, George A.—SL
Kelley, John F.—SC
Kelly, William—CHI
Kelly, William J.—PH
Kelley, William E.—KI
Kellman, Irving H.—ENE
Kellner, William L.—SC
Kelly, Francis P.—CA
Kelly, J. Joseph—PV
Kelsheimer, George E.—NI
Kelso, Joe—DET
Kemp, E. L.—QUE
Kemper, Melvin V.—MV
Kemper, Paul R.—PH
Kemper, William H.—PH
Kempf, J. A.—CHI
Kempf, John N.—SC
Kemps, Anton T.—NWK
Kendall, Charles W.—BUF
Kendall, Donald S., Jr.—ENE
Kendrick, John M.—CI
Kendziorski, Casimir, Jr.—MIL
Kenen, Irvin O.—NWK
Kennedy, Edmund D.—WNE
Kennedy, Trowbridge—BW
Kennelly, William J., Jr.—NWK
Kent, Daniel L.—CA
Kent, Ernest A.—ONT
Kent, John R.—WNE
Keny, G. W.—CO
Keown, Arthur B.—TO
Keown, Earl R.—CHI
Kerekes, T. J.—NWK
Kerisher, George—ENE
Kern, Roy L.—NY
Kerr, R. W.—SL
Kerr, Vernon L.—MIL
Kerseg, W. F.—CHI
Kessler, Gerald—CA
Kessler, Milton—CA
Kessler, Morris—CA
Kettler, Louis—NY
Keusch, Edwin F.—NWK
Keville, John J.—NY
Keyser, M. J.—SS
Keyser, M. R.—CHI
Keyson, Ronald B.—SC
Khachadoorian, Zavan T.—NY
Kieckhefer, Herbert H.—CHI
Kiefel, Albert J.—BI
Kiely, Robert R.—RO
Kies, J. A.—BW
Kiessling, George C.—PI
Kiler, William H., Jr.—BW
Kilfoil, John F.—MV
Killion, Fred T.—NWK
King, Albert D.—WNE
King, Howard R.—SEO
King, Robert W.—CO
King, Stephen B.—WNE
King, William E.—NY
Kingsbury, James T.—CA
Kingstone, F. E.—ONT
Kinney, Paul W.—NWK
Kinsey, Isaac, III—NY
Kinsey, Roy W., Jr.—CHI
Kirby, Herbert R.—SC
Kirby, Russell B., Jr.—UMW
Kirsch, Henry J.—DET
Kissak, George—BW
Kissileff, Adolph J.—PH
Kita, Toshio—OSA
Kitahara, Shigeru—OSA
Kithil, Karl W.—CA
Kithil, Richard—CT
Kittredge, John B.—MV
Kitzmann, Harry E.—DET
Kivett, Jerome S.—KC
Kleha, Francis B.—PH
Kleiderer, Charles W.—NY
Klein, Frederick W., III—PH
Klein, Gerald—MIL
Klein, Irving N.—CHI
Klein, John D.—BW
Kleiner, E. J.—RSM
Kleinfeld, Martin J.—CT
Kleiser, Paul—NWK
Klemtner, William—SC
Klesper, Walter E.—WNE
Kliemann, Rudolph J.—DET
Klimek, Stanley L.—CHI
Klimock, John J.—NWK
Kline, Gordon M.—BW
Kline, Hadley—CA
Kline, Harry—DET
Kline, Samuel M.—PI
Kline, William L.—CO
Kling, Evald L.—NWP
Kling, Robert L.—MIL
Klinger, Rubin—SC
Klinger, Walter—CT
Klonoski, Arthur F.—WNE
Klopstock, Paul, Jr.—ONT
Klorer, Robert W.—SL
Klueger, Max—NY
Klugman, Edmond—SC
Klune, David W.—CA
Knabe, Paul H.—MIL
Knable, Donald E.—DET
Knapp, Stanley M., Jr.—BUF
Knaus, Gilbert M.—NI
Knechtel, Charles E.—ONT
Kneier, Joseph W.—CA
Knell, L. W.—ONT
Knight, J. W.—SEO
Knight, Ralph M.—NY
Knight, Raymond L.—CHI
Knitz, Clinton E.—BI
Knocke, Walter A.—CHI
Knoll, Wayne M.—MIL
Knott, Donald M.—NY
Knowles, Carlton G.—ST
Knowles, Donald G.—CA
Knowles, Roger B.—NWK
Kobak, Robert R.—NY
Koch, George J.—CA
Koch, George H., Jr.—PH
Koch, Karl F.—BUF
Koch, H. Raymond—SL
Kocher, Donald H.—DET
Kochis, Stephen N.—NY
Kociela, Joseph—DET
Koegl, Richard A.—NWK
Koehrmann, Richard H.—SL
Koester, Ralph E.—NWK
Kogan, Leo—SC
Kogos, Laurence—ENE
Kohler, Erik—TO
Koller, John H.—CHI
Kollmeier, Xavier—NY
Koop, Neil A.—NWK
Koplitz, Edward O.—NWK
Kopper, Selwyn—DET
Kopplin, Karl—SL
Korany, Joseph—DET
Korb, Louis L.—MIL
Kordenbrock, H. M.—DET
Korejwa, Alfred—CA
Korman, Melvin—RSM
Korry, Boris V.—PNW
Kosin, Chester L.—NY
Kosiorek, William E.—NWP
Kosobud, William T.—CHI
Kostur, Robert E.—CHI
Kothe, Allan S.—KI
Kotkin, Harold B.—SC
Kovach, George P.—ENE
Kovach, Leslie—PV
Kovacs, George J.—DET
Kovalik, Kenneth J.—NY
Kozma, George—NY
Krach, John F.—WNE
Kraft, Edward L.—PH
Kraft, Fred J.—NWP
Krafthefer, Burl—UMW
Krahn, Ted E.—CI
Krajcik, Milan—CA
Krajewski, Alexander—RSM
Krajnak, Elmer D.—ONT
Krakau, A. Louie—CHI
Krambo, Victor P.—CHI
Kramer, Marvin W.—NY
Kramer, William—TO
Krasnow, Leonard L.—PV
Krause, William W.—ENE
Krausen, Ralph S.—PH
Krawcek, Adolph E.—BI
Krehbiel, J. H.—CHI
Krehbiel, John D.—DET
Kreider, Martin L.—NWK
Kreiner, Thomas J.—RM
Kreiser, C. F.—PI
Kreizel, William J.—NY
Kress, George H.—NWK
Kresser, Theodore O. J.—NWK
Kretkowski, Ben—NY
Kris, Edward J.—BUF
Kristiansen, Edward K.—CO
Krizek, Elmer J.—CA
Kroeger, Heinz—CA
Krone, Frederick A.—NY
Krone, Norman—CI
Kropscott, Earle L.—DET
Krueger, Walter L.—UMW
Kruger, Chester H.—MV
Kruse, Raymond W.—SS
Kruskamp, Leo T.—MV
Kubico, Michael A.—PH
Kucher, Charles G.—KC
Kuchkuda, Roman W.—NWK
Kuettel, G. M.—NWK
Kuffler, H. F.—NY
Kufner, Charles W.—NWP
Kuhlman, Orville E.—KC
Kuhlmann, Henry W.—CO
Kuhn, Jacob H.—DET
Kuhn, L. B.—PH
Kullgren, Gilbert V.—CA
Kulp, John F.—MV
Kummer, James—CO
Kuneman, E. W.—NWP
Kupfrian, Wilbur—BI
Kurko, Andrew—CA
Kurowski, Theodore I.—WNE

L

Laaf, George S.—ENE
Labbee, George M.—SC
La Belle, John W.—PV
La Bounty, T. J.—CHI
La Brie, Armand R.—RSM

La Cava, Jack P.—ENE
Lacey, Edward—WNE
Lachapelle, Raymond—PV
Lachina, Peter—NY
Ladney, Michael, Jr.—DET
Laeis, J. M. E.—NS
Lafitte, George A., Jr.—SS
Lafond, R. G.—QUE
La Grutta, Pascal—NWK
Lahey, Walter D.—CA
Laidman, Lawrence D.—ONT
Lainesse, Benoit—QUE
Lainesse, Bruno—QUE
Lainson, John J.—RM
Lair, W. M.—SEO
Lake, George L.—SS
Lake, John G.—SL
Lally, Robert E.—CA
Lamb, John J.—PH
Lambert, John H.—PHIL
Lamont, Gene D.—DET
Lampman, James R.—RO
Lamprecht, Albert J.—SL
Lamy, Frederick—NY
Land, William M., Jr.—PV
Landall, A. P.—WNE
Lander, Raymond A., Jr.—RO
Landers, Paul D.—SS
Landfield, Harold—CT
Landis, Benjamin M.—NY
Landon, George K., Jr.—CHI
Landry, Raoul J.—SC
Landsberger, Gerard—NY
Lane, Robert M.—NY
Lang, Norman—ONT
Lange, Arthur—NWK
Langermeir, Gregg C.—CA
Langhorst, Frederick—ENE
Langsdorf, Benjamin F. T.—PH
Lansdowne, Homer D.—CA
Lansen, Robert A.—CHI
Lanson, Herman J.—SL
Lantinen, Albert J.—PV
Lanza, Joseph B.—WNE
Lanza, Julian—NWK
Lanzit, Robert G.—MV
La Pointe, Paul—QUE
Larimore, John R.—TO
Larkin, Charles, II—BUF
Larkin, Edwark L., Jr.—NY
Larrick, Ernest D.—SEO
Larrick, Lloyd S.—MV
Larsen, Leonard K.—CHI
Larsen, Robert L.—CA
Larsen, Wilhelm—CHI
Larsen, William M.—CA
Larson, Clifford—NWP
Larson, Milton R.—SL
Larson, Wesley L.—WNE
Lasher, Edward A.—SC
Laspeyres, Paul—NS
Lasser, Allan—CHI
Latham, M. Elber—SC
Lathrum, Henry H.—SC
Latowsky, Harry R., Jr.—PV
Lauck, Alfred W.—PH
Lauer, Keith W.—PV
Laure, George R.—DET
Laurin, David E.—ONT
Lauritzen, Frederick M.—CHI
Lautin, Leon—NY
Lavitt, Seymour E.—WNE
Lawrence, Melville E.—CHI
Lawton, Sanford, Jr.—SL
Lawton, Theodore S., Jr.—WNE
Lawton, William R.—CA
Lax, Harold—NY
Lay, John L.—PH
Layman, Jack—SC
Layton, William B., Jr.—GG
Lazzara, Ralph P.—WNE
Leach, William F.—ENE
Leaf, George W.—NY
Leape, Charles B.—SS
Leary, Richard E.—ENE
Lease, John H.—GG
Leaver, G. J.—RSM
Lechner, Albert M.—CHI
Lecky, Herbert S.—PH
Le Craw, C. Veazey—SS
Leder, Chester R.—PH
Lee, Max M.—NI
Lees, John M.—ONT
Leet, Donald A.—NWP
Leghorn, Kenneth M.—NWK
Lehman, Richard A.—RO
Lehosky, James M.—SS
Lehr, James C.—PH
Leichman, William W.—SS
Leichner, William G.—NI
Leidel, William F., Jr.—NY
Leider, Gregory J.—MIL
Leigh, Frank C.—PNW
Leimseider, Edward B.—NY
Leinbach, Harry B., Jr.—MV
Leipold, W. C.—NWK
Leiske, Roy R.—MIL
Leiter, R. M.—NWK
Lekosky, Edward F.—SL
Lelievre, Andre—NS
Lelugas, Joseph J.—CHI
Lemaster, Robert—MIL
Le Moine, Donald E.—PI
Lemoine, Everett C.—PV
Lemonier, C. R.—NY
Lennon, Charles F.—RO
Lens, Karl G.—NY
Lensky, Albert—NY
Lentz, James W.—PV
Leo, John P.—PV
Leonard, Fred—BW
Leonard, Philip A.—NI
Leonard, Vernon F.—RM
Leone, Edmond A.—BUF
Leone, Leonard H.—BUF
Leonowich, Stanley—CA
Lepine, Louis A.—CT
Lerman, Jerry—NY
Lermer, Herman B.—NWK
Lerner, Louis L.—CHI
Leroux, Roger—QUE
Lescher, R. F.—CHI
Less, Frank W.—DET
Lessheim, Arno—DET
Lester, William M.—NWK
Leuthold, Donald W.—PNW
Levey, H. A.—NS
Levin, Allan F.—PH
Levin, Carl—CHI
Levin, Monte L.—NY
Levine, Bernard B.—NY
Levine, Charles J.—RO
Levine, Marvin S.—CHI
Levine, Morton—PV
Levites, Solomon—BI
Levy, Marshall M.—NY
Levy, Murray D.—NWK
Lew, Baak Wai—PH
Lewellen, W. G., Jr.—DET
Lewi, William—NY
Lewis, A. Beverley—QUE
Lewis, Daniel—NY
Lewis, Donald H.—CA
Lewis, Gerald—NWP
Lewis, Jerome—NY
Lewis, Kemble S.—CA
Lewis, Lawrence—CA
Lewis, Robert—NY
Lewis, Seymour—NY
Le Witter, Robert D.—DET
Leyes, Charles E.—NWK
Libbey, James T.—DET
Lichtenberg, Charles—WNE
Lichtenstein, Dan—NWK
Lightbody, Albert—BW
Likos, Milton E.—GG
Lince, Earl F.—ONT
Lind, Carl J.—CHI
Lind, Ted N., Jr.—CHI
Lindahl, Fred J.—CHI
Lindau, Jules W., III—SS
Linderman, John L.—DET
Lindh, Gunnar C. T.—DET
Lindlaw, William—NWK
Lindquist, Gunnar—CT
Lindsay, James P.—PH
Lindsay, John—RM
Lindstrom, Althen C.—RSM
Lindvig, Philip E.—PH
Link, Floyd W.—NI
Linn, Carl F.—CA
Linson, Donald H.—CA
Linton, W. Henry, Jr.—PH
Linzell, Arthur S.—DET
Linzer, Robert—NWK
Lipke, Paul H., Jr.—DET
Lippa, Fred F.—RO
Lipscomb, G. F., Jr.—SS
Liptak, Paul P.—NWK
Liscovitz, George—CA
Liss, Jack—NY
Lister, James M.—CHI
Litzinger, Robert J.—NWP
Livermore, Russell P.—DET
Lloyd, John B.—CI
Lober, Russell E.—PI
Lochner, Robert L.—NI
Locke, Frederic J.—WNE
Loconto, Arnold A.—WNE
Lodge, Walter S.—SC
Loeffelman, Howard G.—SEO
Loehr, Heinrich—DET
Loesing, Joseph B., Jr.—NY
Loewenthal, Leon A.—SC
Logel, Paul E.—BUF
Logozzo, Arthur W.—WNE
Lohman, Sidney W.—RSM
Lombard, Frank A.—NWK
Lombardi, Amico J.—CT
Lombardi, John P.—NWK
Lombardo, Murray D.—PHIL
Long, Alfred R.—ONT
Long, Edward E.—NI
Longacre, Walter B.—CHI
Longstreth, Joseph G.—SL
Lonning, Thor J. G.—WNE
Loomis, E. L.—SL
Lopez, Richard C.—CA
Loranger, J. Albert—NWP
Lordly, L. Chester—NWK
Lorentz, Robert C.—NWK
Lorenz, A. J.—PV
Lorenz, Rudolph, Jr.—GG
Loring, Herbert F.—SS
Losito, Joseph M.—BUF
Loucks, Harvey L.—BUF
Louden, James R.—BW
Louden, Lilyon E.—NY
Louer, John C.—CHI
Louik, Leonard—PI
Louik, Martin—CHI
Louis, Robert K.—UMW
Lovallo, Carmine—NWK
Lovallo, Joseph N.—NWK
Love, William C.—CA
Loveless, Lawrence M.—RO
Loveless, Thomas L.—NWK
Lovezzola, Robert F.—ENE
Lovgren, Arthur—CHI
Lowe, Cabell L.—SS
Lowery, Robert E.—TO
Lowry, Robert D.—ENE
Lubin, George—NY
Lucas, Anatole M.—UMW
Lucas, Glenn E.—SC
Lucid, David E.—MV
Luckino, Patrick J.—DET
Luckow, Joseph—NY
Ludascher, W. C.—PH
Lufkin, Chancey F., Jr.—SC
Lull, Emanuel E.—RO
Lumbard, Edward B.—CHI
Lundberg, Willard—SC
Lundsten, Stanley L.—DET
Lundwall, Rodney E.—NWP
Lunn, James S.—NY
Lupo, Joseph—NY
Luscombe, T. A.—ONT
Luscusk, Paul C.—KC
Luskin, Robert G.—SC
Luster, Carl J.—CT

Lutton, Lyle—BW
Lutz, John C.—SC
Lybeck, Alvin H.—CT
Lyckberg, Berndt K.—PH
Lyday, Richard W.—MV
Lyman, John R.—ST
Lynch, H. A. Wilfred—MIL
Lynch, John E., Jr.—RSM
Lynn, Edwin W.—NWK
Lyon LeRoy—MV
Lyons, Joseph H.—SC
Lytle, William W.—CA

M

Maass, Edward W.—WNE
Maassen, Gustav C.—NY
Mabey, William E.—NWK
Mabry, Guy O.—KC
Mac Almon, Edward L.—NWK
Mac Arthur, Hamilton E.—TO
Mac Beth, Stanley E.—ONT
Maccaferri, Mario—NY
Mac Donald, James E.—DET
Mac Donald, Roger—PI
Mac Donald, Stuart—DET
Mac Indoe, George F.—BI
Mac Isaac, Kenneth L.—DET
Mack, John—CHI
Mack, John L., Jr.—CHI
Mack, John M.—MV
Mackenzie, W. B.—NY
Mackessy, Richard F.—PH
Mackey, Eric—NY
Macksey, Kenneth W.—NWK
Mac Laine, Ian A.—QUE
Mac Lennan, Duncan J.—PI
Mac Leod, L. C.—QUE
Mac Lise, L. G.—GG
Mac Martin, William S.—DET
Mac Neill, H. N.—PH
Mac Phee, Paul A.—ST
Mac Phersen, William C.—SS
Mac Pherson, J. A.—ONT
Mac Rae, Francis J.—DET
Madden, S. G.—NWK
Madenwald, Frederic A.—MIL
Maddock, Bruce H.—NWK
Maess, Frank M.—MV
Maffia, John—NY
Magee, John F., Jr.—CA
Magee, Robert C.—NY
Magnenat, Rene P.—CT
Magner, Philip, Jr.—NI
Magnuson, E. E.—DET
Magnussen, F. C.—BUF
Magruder, Guyler—GG
Magruder, William R.—KC
Mahan, Daniel R.—PV
Maher, James T., Jr.—NI
Maher, Walter A.—RSM
Mahle, William H.—UMW
Mahlmann, Charles V.—ENE
Mahoney, Tennis—NI
Maibrunn, Myron—NY
Maier, Robert E.—PHIL
Main, Gaylord W.—SC
Maine, DeWitt C.—SC
Mains, Gerald H.—PH
Maisel, Melvin L.—NY
Maiter, Arthur E.—PH
Maizie, Paul W.—NWP
Majewski, John W.—PH
Major, Richard K.—KI
Makeever, Viola B.—ENE
Malamphy, Richard H.—CT
Malby, Howard S.—SC
Malek, Edward J.—CA
Malianni, Theodore V.—GG
Malinowski, Theodore P.—PH
Mallen, Edward J., Jr.—SC
Mallett, Hugh K.—SEO
Mallory, John W.—WNE
Malmberg, William A.—PH
Malo, Urbain J. H.—RSM
Malone, Maurice F.—QUE
Malone, Roger W., Jr.—CI
Malpocker, Louis—SL
Manganelli, Michael A.—WNE
Mangin, Gerard F.—SL
Mangino, Dominick D.—KI
Manley, Frank H., Jr.—BUF
Mann, Basil E.—NWK
Manning, Joseph F.—ENE
Manring, William E.—CA
Mansfield, George E.—NWK
Manzella, Joseph J.—PV
Marberg, Carl M.—CHI
Marceau, Gerard J.—CHI
Marcey, Stephen D.—MV
Marchak, Nicholas—NWK
Marciniak, Emil—WNE
Marcucilli, Armand—NY
Marcus, Paul—NY
Marcus, Stanley A.—DET
Marcy, Robert J.—NWK
Maresca, Anthony M.—NWK
Margrill, Herbert—NY
Margus, Edward A.—NWK
Marino, Joseph A.—PI
Mark, Richard—NY
Markhoff, Charles E.—PH
Marks, L. F.—PI
Markwood, William H., Jr.—PH
Marlowe, Murray—NY
Marmen, J. Mark—NWK
Marquardt, Carl G., Jr.—NY
Marra, Frank S.—DET
Marsh, E. S.—CHI
Marshall, Andrew C.—SC
Marta, Anthony S.—DET
Martel, Richard A.—SC
Martens, Charles E.—ST
Martens, Stanton C.—CT
Martin, Elizabeth D.—NY
Martin, Frank A.—CA
Martin, George—WNE
Martin, James M.—ENE
Martin, James O.—NI
Martin, John P.—PH
Martin, Maurice—NY
Martin, Oliver E., Jr.—SS
Martin, R. A.—ONT
Martin, Richard H., Jr.—WNE
Martin, Sidney M.—ST
Martin, W. D.—CA
Martin, William P.—WNE
Martinelli, Guy A.—NY
Martinez, Y. M.—CHI
Maruchnics, George G.—CA
Marvel, Jackson—CHI
Marvin, John M.—WNE
Marx, Erich—SC
Marx, William A.—NWK
Masciarelli, Alberico—ENE
Mason, Albert J.—DET
Mason, D. F.—QUE
Mass, Herbert M.—NY
Masson, Donald—CO
Massopust, C. F.—CHI
Masterson, Frank—SS
Mastriano, Henry N.—CT
Matarazzo, Ralph G.—BW
Mate, Julius C.—NWP
Mathews, Robert S.—UMW
Mattimoe, P. T.—TO
Maute, Bernhard W.—NWK
Maxson, Orwin G.—SC
Maxwell, Bryce—NWK
Maybee, Roderick M.—NWK
Mayer, Hans—SC
Mayer, Mark G.—NWK
Mayurnik, George—NY
Maywald, Frederick J.—NWK
Mazer, M.—MV
Mazia, Joseph—BW
Mazoff, Michael—NY
Mazur, Raymond A.—WNE
Mazzarelli, August M.—NY
Mazzarelli, Frank—NY
Mazzur, Frank C.—NWK
Mc Afee, Daniel B.—PH
McAllister, Richard L.—SS
Mc Aulay, Alex—CT
Mc Bride, Edward T.—NWK
Mc Bride, John S.—NY
Mc Brien, William K.—ENE
Mc Cabe, Robert F.—CHI
Mc Cann, Charles—PH
Mc Cann, Hiram—NY
Mc Carthy, Lawrence A.—ENE
Mc Carthy, Robert A.—WNE
Mc Carthy, Vincent D.—NY
Mc Cauley, Donald S.—NY
Mc Cauley, John W., III—SS
Mc Clellan, Ernest E.—CA
Mc Clure, James Q. A.—PI
Mc Clure, Peter R.—ENE
Mc Clure, Wilbur F.—MV
Mc Connell, Robert K.—WNE
Mc Connell, William R.—DET
Mc Convey, Alan J.—ONT
Mc Cormack, Donald C.—ONT
Mc Cormick, Clarence—CHI
Mc Cormick, George C.—PH
Mc Cormish, W. E.—CHI
Mc Cosh, Frederick I.—DET
Mc Coy, William C., Jr.—CA
Mc Crady, Frank E.—ENE
Mc Cready, Donald L., Jr.—BW
Mc Creery, Albert J.—RSM
Mc Cuen, Donald L.—NS
Mc Culla, Robert K.—MV
Mc Culloch, W. J. G.—NWK
Mc Cutcheon, Robert J.—CA
Mc Daniel, Howard M.—CA
Mc Donald, Dale—SC
Mc Donald, J. N., Jr.—ENE
Mc Donald, Le Roy R.—SC
Mc Donald, Roland D.—BUF
Mc Dorman, Robert S.—SL
Mc Duff, James M.—ST
Mc Elligott, Edward M.—PH
Mc Elroy, Samuel A.—CA
Mc Ewen, F. W.—ONT
Mc Ewen, J. E.—ONT
Mc Farland, Richard M.—NY
Mc Geachie, William J.—ONT
Mc Gee, Richard—UMW
Mc Gee, Robert M.—CT
Mc Ginnis, John G.—PI
Mc Glone, William R.—SC
Mc Gowan, Harry J.—DET
Mc Grath, Maurice F., Jr.—NY
Mc Graw, John J.—PH
McGrew, Frank C.—PHIL
Mc Guire, John D.—CI
Mc Guire, Thomas M.—NWK
Mc Ilwain, Roger I.—DET
Mc Intosh, W. J.—PH
Mc Intyre, Albert R.—PV
Mc Intyre, Don R.—DET
Mc Intyre, Frederick W., Jr.—PV
Mc Kay, William C.—BW
Mc Kechnie, William V.—ENE
Mc Kee, David—SC
Mc Kee, Robert Bruce, Jr.—DET
Mc Kenna, Carroll P.—ST
Mc Kenna, Lawrence A.—NWK
Mc Kenzie, T. Curtis—DET
Mc Kinney, Edwin J.—SC
Mc Lain, William G.—CA
Mc Lain, William R.—CA
Mc Laughlan, T. R.—WNE
Mc Laughlin, John A.—BI
Mc Lean, George K.—SC
Mc Lellan, Thoman A.—ONT
Mc Mahan, Wilbur G.—CI
Mc Mahon, E. K.—KI
Mc Millan, Bruce T.—NWK
Mc Minn, C. E.—CI
Mc Minn, Roland A.—CHI
Mc Mullen, James F.—CT
Mc Nally, Robert J.—PV
Mc Nash, Howard H.—CA
Mc Naughton, Thomas W.—ENE
Mc Nearney, Thomas O., Jr.—SL
Mc Neill, Blakely R.—WNE

Mc Nulty, Daniel S.—DET
Mc Pherson, John A.—DET
Mc Quillan, Jack A.—SL
Mc Sheehy, William H.—ENE
Mc Sweeney, E. E.—CO
Mc Vickar, Henry L., Jr.—RSM
Mc Williams, John O.—CA
Meacham, Fred C.—NY
Means, Fred C.—WNE
Mears, Vincent L.—NWK
Meath, William A.—ST
Meckauer, Henry F.—NY
Medina, Henry—CA
Medl, Robert C., Jr.—CHI
Medoro, Albert M., Jr.—RO
Meeker, David—MV
Meglino, Nicholas—NY
Meister, Travis H.—DET
Meklembourg, Harry L.—NY
Melack, Michael—NWK
Melchore, James A.—NY
Meldrum, Kenneth—DET
Melnick, Sidney—CHI
Meltzer, Maurice—CHI
Melville, Richard J.—RO
Melvin, George H.—SS
Melvin, S. R.—WNE
Memering, Leroy J.—NWK
Mendes, Anthony A.—NWK
Menegus, Bruno V.—NWK
Mengucci, John R.—BI
Menkel, Gary G.—NY
Merck, Walter J.—NY
Meredith, Lloyd A.—QUE
Merke, Joseph—MV
Merrill, Arthur M.—NY
Merrill, Elwyn E.—WNE
Merrill, Victor Q.—NWK
Mersey, David—CT
Merszei, Zoltan—ONT
Merz, Peter H.—NY
Messenger, David L.—RO
Messina, William A.—CA
Metcalf, Emerson D.—SC
Metzger, Arthur—NY
Metzger, Paul J.—NY
Meyer, Arnold M., Jr.—NY
Meyer, Charles F.—PI
Meyer, Fred J.—ST
Meyer, Garson—RO
Meyer, Herbert—SC
Meyer, Joseph E.—NWK
Meyer, Leonard S.—CO
Meyer, Raymond W.—ST
Meyer, Walter B.—SL
Meyer, Walter H.—CA
Meyer, Werner T.—RO
Meyers, David—CHI
Meyers, George E.—NY
Meyrick, Harold A.—CI
Miale, Peter M.—NY
Michal, Edward V.—NWK
Michalski, Steve—NI
Michaud, C. L.—NWK
Michel, Kenneth G.—NWK
Michels, Alfred J.—SC
Michl, Edward F.—SEO
Midyette, Allen L., Jr.—WNE
Mighton, John W.—DET
Miksch, Mathan—NWK
Miler, Richard W.—DET
Miles, A. David—DET
Miles, Robert E.—NY
Mileto, Anthony F.—BW
Millar, Robert R.—KI
Millard, Raymond L.—RM
Miller, Allan F.—PV
Miller, Bruce M.—PI
Miller, Charles M.—SC
Miller, Cloven E.—CA
Miller, Don R.—CHI
Miller, Earl—MIL
Miller, Edward L.—CO
Miller, Ernest J.—RM
Miller, Francis L.—MV
Miller, Fred B.—PNW
Miller, Hugh L.—QUE
Miller, Jerome L.—NY
Miller, Michael—NY
Miller, Nels A.—CHI
Miller, Robert W.—BUF
Miller, Thomas W.—SC
Miller, William P.—CI
Millholland, Wm. K., Jr.—CI
Millier, Armand—DET
Milligan, Allan—DET
Millington, William H., Jr.—KC
Mills, Elmer E.—CHI
Mills, John S.—RO
Mills, Robert J.—NY
Milnes, Randolph G.—PH
Milton, Clare L.—BW
Milward, Frank W.—CHI
Mineau, Marcel—QUE
Miner, Arnold E.—ENE
Miner, Charles, Jr.—CT
Miner, Frederic I.—RSM
Miner, John E.—BUF
Minnick, Gerald D.—TO
Miskella, William J.—CA
Mistretta, Raymond S.—NWK
Mittel, William A.—CHI
Mittelstadt, Norbert—MIL
Mizuhara, S. J.—QUE
Moats, Morris M.—DET
Modigliani, D. P.—NY
Modjeski, Howard F.—CHI
Mohr, Wilfred J.—SS
Molen, Franklin B.—CHI
Mollman, Robert E.—CA
Monaco, Foster—NY
Monaco, Leonard A.—SEO
Monaco, Roe—NY
Monaco, Sam—NY
Monaghan, Gerald J.—NY
Monahan, William C.—CT
Monahan, William J.—RSM
Mondano, Ralph L.—ENE
Moneyhon, Robert J.—PH
Monster, Jack—ONT
Montagna, Leo J.—PV
Montgomery, Herbert C.—ONT
Monti, Peter D.—NY
Moody, Arthur F.—WNE
Mooney, Edward W.—SL
Mooney, Fred E.—ENE
Mooney, Melvin—NWK
Moore, Clarence M., Jr.—KC
Moore, Eugene C.—SL
Moore, H. Earl—DET
Moore, J. Franklin—CHI
Moore, John B., Jr.—GG
Moore, John T.—PV
Moore, Lloyd T.—NWP
Moore, Robert A.—SL
Moore, Robert L.—PH
Moore, Shelton H.—BW
Moore, William L.—PH
Mooy, Richard W.—CHI
Moratti, Gino—CT
Morcom, Richard J.—WNE
Moreland, Ben A.—PI
Morehouse, Laurence C., Jr.—PH
Morehouse, Robert H.—KI
Morgan, Bertram—ENE
Morgan, C. P.—PH
Morgenstern, Henri—NY
Moricoli, John C.—CA
Morie, Fred C.—SL
Morningstar, Otto—ENE
Moroney, John F.—NWK
Moroz, Peter J.—PH
Morrell, Clyde E.—WNE
Morrill, John L.—GG
Morris, Earl D.—DET
Morris, James J.—NY
Morris, John F.—KC
Morris, John K.—PV
Morris, Joseph R.—QUE
Morris, Parker W.—BW
Morris, Robert F.—DET
Morrison, A. G.—UMW
Morrison, Donne I.—RSM
Morrison, J.—ONT
Morrison, L. J.—DET
Morrison, M. E.—QUE
Morrissy, James E.—CHI
Morrow, A. R.—DET
Morse, A. Reynolds—CA
Morse, Clifford G.—RO
Morse, George T.—NWK
Mosak, John B.—CHI
Moscicki, Leo A.—BW
Mosher, Dale F.—DET
Moslo, Bernard J.—CA
Moslo, Ernest P.—CA
Moss, Hibbert W.—NWK
Moss, John—NY
Moss, Nathan S.—NY
Moss, William M.—WNE
Motten, Roger H., Jr.—NY
Moulthrop, Homer A.—PNW
Moulton, M. Scott—SC
Moxness, S. K.—UMW
Moyer, Alfred E.—BUF
Moyer, Robert R.—WNE
Moylan, James J.—TO
Muckenfuss, Thomas F.—PH
Mueller, Charles S.—MV
Mueller, Eugene F.—NWK
Muir, Andrew C.—CHI
Muldoon, Thomas J.—NWK
Mulholland, W. G.—ONT
Muller, John E.—CA
Mullins, Denis J.—NWK
Multer, Robert K.—CHI
Munkacsy, Ernest A.—CA
Munn, Harry O.—SL
Munns, David A.—NY
Munro, John A.—QUE
Munro, Kenneth E.—CHI
Munyak, John A.—NWK
Murdoch, Colin D.—GG
Murphy, Edward B.—ENE
Murphy, Frederick V., Jr.—RSM
Murphy, Harold T.—CA
Murphy, J. Donald—ST
Murphy James P.—NWP
Murphy, Paul T.—UMW
Murphy, Russell S.—WNE
Murphy, Thomas J.—PV
Murphy, Thomas P.—NY
Murray, Albert H.—NY
Murray, Charles F.—CHI
Murray, Donald L.—PH
Murray, J. A.—ENE
Murray, Joseph F.—BI
Musgrave, Thomas F.—CA
Muto, A. Douglas—WNE
Muttera, William H., Jr.—MIL
Myers, Dale C.—NI
Myers, John G.—DET
Myers, John H., III—MV
Myers, Richard E.—MV
Myers, Robert G., Jr.—ST
Myers, Wayne C.—BI
Myerson, Richard L.—ENE
Myles, James R.—NY
Myles, William A.—NY
Myllykangas, Waino W.—ENE

N

Nadel, Murray—NY
Nagy, Julius J.—CHI
Najar, Thomas J.—NY
Nakai, Tadatoshi—OSA
Nakamori, Kiyoshi—OSA
Nakao, Tadao—OSA
Nakayama, Kiyotsugu—OSA
Nalle, George Jr.—ST
Namm, Arthur B.—NY
Nanke, J. Arthur—BW
Napravnik, August—NWK
Narigan, Harold W.—PH
Nast, Leo—PH

Nathan, Haiman S.—BUF
Nathan, Jerome H.—BUF
Nathanson, Bennett—WNE
Naturale, Anthony—NWK
Naturale, Joseph W.—NWK
Naul, G. M.—SS
Nault, Henry J.—NI
Nauth, Raymond—DET
Nazar, A. R.—TO
Neary, Anthony J.—CO
Nehemiah, Maurice A.—NY
Neitlich, Mark W.—NWK
Nellis, Adin A. Jr.—PH
Nelson, A. William—CHI
Nelson, Byron W.—MV
Nelson, John F.—CHI
Nelson, Melven V.—CHI
Nelson, Marle F.—MV
Nelson, Philip S.—WNE
Nelson, Reginald E.—ONT
Nelson, R. S.—ONT
Nelson, William K.—UMW
Nering, Theodore Jr.—CHI
Neros, Clifford A.—CA
Nester, J. E.—NY
Neumann, Clarence P.—DET
Neumann, J. A.—CA
Neville, Thomas W.—CI
Neward, George A.—RO
Newberg, Raymond G.—NWK
Newcomb, Benjamin R.—NWK
Newell, D. M.—ST
Newhall, Richard C.—GG
Newman, Donald R.—CA
Newman, Edgar P.—ONT
Newman, Ferris E.—NI
Newman, Irving I.—RSM
Newsom, Brantley I.—GG
Niborski, Melloch—NS
Nicely, Wayne—CI
Nicholas, Aristides S.—DET
Nicholl, J. F.—NWK
Nichols, Anthony—PV
Nichols, Gaylord E.—SC
Nichols, James A.—BW
Nichols, Malcolm A.—DET
Nicholson, Bradford L.—SS
Nicholson, Nick A.—SC
Nicholson, William—CHI
Nick, Alexander M.—DET
Nickerson, Mortimer H.—WNE
Nickless, Herbert C.—ENE
Nickless W. Harmon—DET
Niclaus, William L.—NWK
Nicol, William H.—CA
Niebuhr, A. F.—BW
Niehaus, Frank—SL
Nielsen, Alvin R.—WNE
Nielsen, George C.—PH
Nielsen, Paul O.—SC
Nielson, Carl A.—BW
Niemi, Oscar E.—CHI
Nilo, Salvatore C.—NY
Niquette, Earl G. Jr.—RSM
Nishimura, Rihei—OSA
Nispel, Alfred C.—ENE
Nissel, Frank R.—NWK
Nissen, William C. Jr.—ENE
Nissle, William N.—PH
Nitzberg, Daniel I.—BW
Nixdorff, Frank S. Jr.—PH
Noble, Ralph A.—QUE
Noble, Sid—NY
Noble, T. Walker—MIL
Nock, T. G.—NY
Noe, Leon R.—NY
Nolan, John L.—CHI
Nord, George H.—ONT
Norgren, Leigh H.—RM
Norman, Richard M.—MV
Normandin, Raymond O.—ENE
Norris, Frank C.—SC
Norris, R. W.—ST
Northrop, George S.—NY
Norton, Kenneth C.—CA
Norton, William H.—CHI
Novak, Izador J.—CT
Novotny, Ernest E.—PH
Nowaczyk, John—PH
Nowaczyk, T. F.—NWP
Nufer, Arthur—NWK
Nussbaum, Frank J.—NY
Nutter, Donald M.—UMW
Nyborg, Preben—NS
Nyquist, Arthur S.—CT

O

Oakley, N. Bruce—ENE
Obata, Shigekazu—OSA
Oberkircher, F. D.—NWP
Oberle, Henry J.—PI
Oblinger, Gates S.—BUF
O'Brien, George M.—NY
O'Brien, John C.—NWK
O'Brien, Paul J.—SL
O'Brien, Philip—CHI
O'Brien, Thomas W.—CHI
O'Connell, John J.—NY
O'Connor, Martin J.—MIL
O'Connor, Hubert P.—RSM
O'Connor, Richard T.—ENE
O'Donnell, Charles P.—WNE
O'Donnell, John R.—PHIL
Oehling, Ernest L.—SEO
Oelman, Walter F.—MV
Oettinger, Henry Jr.—NY
Ogando, Joseph A. Jr.—NWK
Ogden, F. Faxon—PH
Ogden, Oscar H.—CI
Ogeman, Elon T. V.—NS
Oglesby, Richard C.—DET
O'Hagan, William D.—NWK
O'Hara, Raymond J.—CA
O'Hearn, Joseph J.—RO
O'Kane, Robert G.—ENE
Okie, James P.—CA
Oldham, W. N.—WNE
Oleesky, Samuel S.—SC
Oleksiak, Richard—BUF
Oler, T. Milton Jr.—BW
Oliva, Samuel A.—CT
Oliver, Herbert D. Jr.—CA
Olsen, Harry O. Jr.—RSM
Olsen, Martin A.—NY
Olsen, M. A.—NWK
Olson, Harold M.—CA
Olson, Wiliam E.—PV
Ondrejko, John G.—SEO
O'Neal, Paul S.—ENE
O'Neil, Frank V.—NY
O'Neill, James P.—SL
Onik, John K.—SL
Oppenheim, Joseph G. Jr.—NY
Ord, Harold V.—SC
Orloff, Dale L.—NY
Orlow, Alfred—MV
Orme, Thomas R.—CHI
Orr, Alfred T.—ONT
Orr, Henry J.—CA
Orr, John B.—WNE
Orr, Kathryn D.—CA
Orr, Leslie G.—KC
Ortner, John F.—NY
Osborn, Wayne J.—NWP
Osborne, Edward B.—CA
Osborne, N. W. Jr.—CA
Osborne, R. S.—ENE
Oshima, Keiji—OSA
Oskin, Ernest T.—PHIL
Ostkar, Joseph W.—CA
Ostlund, Eric—DET
Ostoich, Eli—MIL
Oswald, Paul F.—NS
O'Toole, John E.—WNE
O'Toole, John L.—NWK
Otto, Dan E.—SL
Ouellette, Norman J.—PV
Overholt, G. T. Jr.—NY
Overwein, Joseph H.—MV
Oveson, Elvin A.—UMW
Owen, Charles R.—CA
Owen, LeRoy—UMW

P

Packheiser, Frank—CHI
Pacia, Frank—NY
Page, Katharine—ENE
Page, Leon J.—NI
Painter, Arthur H.—ONT
Pajak, Theodore P.—BW
Palen, Julius W.—GG
Pallene, Ralph J.—WNE
Palmer, Edwin F.—RO
Palmer, Lewis E.—SEO
Palmer, N. J.—NS
Palmer, S. E.—NWK
Palmquist, David E.—QUE
Pamatat, Clinton A.—NY
Pamatat, Elwood G.—NY
Pancoast, Harry E.—SL
Pandolfo, George—NY
Pannhausen, John—CHI
Pare, Girard F.—WNE
Paris, Walter R.—PV
Park, Ford R., Jr.—NY
Park, Joseph D.—RM
Parker, Gerald F.—ONT
Parker, J. C., Jr.—ENE
Parker, J. P.—ONT
Parker, Mitchell—PI
Parker, Robert M.—KI
Parker, Walter B.—ENE
Parker, Willard G.—NY
Parkes, Sidney—ONT
Parkhill, J. E.—ONT
Parks, C. E.—CA
Parks, James G.—SS
Parks, John E.—PI
Parks, Lloyd E.—SS
Parks, Robert M.—SL
Parliman, J. H.—WNE
Parmett, George L.—NY
Parry, Harvey L.—NWK
Parsekian, Harold M.—CT
Parsekian, Richard A.—NWK
Partridge, Howard W.—NY
Pasowicz, Walter E.—CHI
Pastore, Ronald M.—NY
Paton, John B.—PH
Patrick, Loren A.—SC
Patrick, Robert J.—NY
Patrinelli, Harry—PV
Patterson, Albert F.—RO
Patterson, Charles G.—CA
Patterson, LeRoy R. Jr.—KI
Patti, Dante J.—ENE
Paul, Julian—ENE
Paul, Samuel—DET
Paulen, Jacques R.—SS
Paulishak, Peter P.—CT
Paulus, George F.—NWK
Pavanel, John C.—ONT
Pavlick, George E.—CA
Payne, Albert E.—MV
Payne, George P.—KI
Payne, Roy R. Jr.—PV
Peacock, Walter W.—ENE
Peacock, William H.—NWK
Pearce, Woodrow W.—SC
Pearl, Curtis F.—NY
Pearlman, Joseph—NY
Pearse, Wilford A. Jr.—CA
Peasley, W. Kenneth—SC
Peat, Roy L.—SC
Pebly, Harry E. Jr.—NWK
Pecchiai, Renato—NS
Pechman, Jack R.—RM
Pechulis, Charles P.—ENE
Peck, George A.—RO
Peck, Guy S.—BI

Peck, J. A.—BUF
Pecktal, Jack R.—CA
Pedersen, Joseph R.—CHI
Pedersen, Vaughn—CHI
Pedrotti, R. J.—WNE
Peiler, William H.—KC
Pelensky, John F.—NWK
Pelikan, Rolf—NY
Pelletier, Robert I.—ENE
Pensado, Frank—SS
Pentland, Lewis J.—CT
Perdue, L. M.—PNW
Perkins, Kenneth—NWK
Perkins, Raymond S.—NS
Perlberg, S. Everett—NWK
Perlman, Harry—NY
Perlmutter, Charles—NY
Perlmutter, Donald—NWK
Perloff, John W.—ENE
Pernik, John F. Jr.—MV
Perras, Henry A.—WNE
Perreault, G. V.—WNE
Perrine, J. Franklin—NY
Perron, Robert—CT
Perry, Eli—ST
Perry, H. A. Jr.—BW
Perry, Norman L.—NY
Perry, Rodney S.—RO
Perzan, Harry J.—CHI
Peter, Richard C.—KI
Peters, Abram—DET
Peters, M. W.—NWK
Petersen, Fred F.—NY
Peterson, Fred D.—GG
Peterson, John—CHI
Peterson, Lloyd A.—CHI
Peterson, Milton O.—CHI
Peterson, R. T.—RO
Peterson, Warren E.—NWK
Pethybridge, Donald F.—PV
Petretti, Mario J.—SEO
Petruccelli, Frank—NWK
Pettersson, Ragnar L.—NS
Pettit, James A., Jr.—WNE
Pfaff, Peter—NWK
Pfaff, William G.—NY
Pflederer, Fred R.—MIL
Pfunter, Jordan—SS
Phelps, G. W.—PH
Phelps, Horace N.—MV
Phelps, Richard C.—CI
Philbin, David J.—BI
Philbrick, Warren W.—PNW
Philipson, Paul P.—NY
Phillips, Daniel N.—NY
Phillips, David—DET
Phillips, Forrest E.—NWK
Phillips, Lewis L.—TO
Phillips, Martin A. Jr.—CA
Phillips, Ralph O.—DET
Phillips, Raymond F.—CHI
Phillips, William J.—NWP
Philipson, Goran—NS
Philipson, Joseph—SC
Phipps, John B.—CA
Picard, John A.—DET
Pick, Joseph Jr.—PI
Pickering, C. C. Jr.—BUF
Pickering, George E.—PV
Pierce, Elliot S.—BW
Pierce, Russell F.—CHI
Pierson, Samuel D.—CT
Pilat, Theodore J.—CHI
Pinck, George L. A.—QUE
Pinkston, James T. Jr.—ST
Pinsky, Jules—WNE
Pintar, A. L.—CHI
Pioch, Herb W.—TO
Pittenger, C. R.—NWK
Pittenger, James E.—DET
Pladek, Oscar J.—NWK
Planck, Ivan A.—NI
Plant, Henry T.—NS
Plasewicz, C. F.—BW
Plaskett, Clyde A.—NY
Plato, Ing G.—NS
Platt, Cort—NMW
Plichta, Richard J.—WNE
Plimmer, Alfred G.—MV
Plisco, William B.—NY
Plitt, Karl F.—BW
Plowright, Robert D.—CHI
Plum, Myron W.—SC
Plume, David S.—NWK
Plummer, John C.—SC
Pochel, Martin L.—CHI
Poindexter, Emmet W. Jr.—NWK
Pokigo, Francis J.—WNE
Poli, Emilio L.—DET
Pollack, Albert R.—PH
Pollack, Maxwell A.—NWK
Pollard, Robert E.—WNE
Polson, Allen E.—CA
Pomper, Anthony W.—NWK
Poole, R. W. Jr.—WNE
Porte, Jack W.—SL
Porte, N. H.—CHI
Portenier, Donald E.—NWP
Porter, Benjamin T.—CHI
Porter, George B.—PI
Porter, George W.—CT
Porter, Robert F. Jr.—RSM
Porth, Irving H.—CHI
Posey, Thomas J.—SC
Post, Ronald W.—NWK
Potapchuk, William—CA
Potischman, Edward K.—ENE
Potoczky, Joseph B.—SC
Potter, Henry B.—NWP
Potter, W. D.—MV
Potts, William G.—CHI
Poust, M. L.—CHI
Powazi, Joseph—NY
Powell, Paul U.—CI
Powell, Richard E.—NY
Power, C. James—ONT
Powers, Don M.—SS
Powers, L. Jack—QUE
Prah, Harry F.—CI
Prall, George M.—SL
Pranitis, Leo J.—BI
Prassl, Anton—NWK
Preiss, Herbert—NY
Prelogar, W. H.—KC
Prescott, Francis J.—NY
Presson, Peter H.—CA
Preston, E. Kirby—NWK
Preston, Mark D.—SC
Preston, Willard M.—NWK
Preuss, Peter P.—NWK
Pribble, Wayne I.—NI
Price, Floyd L.—SC
Price, James E.—PH
Price, Richard H.—SEO
Price, Robert K.—SS
Price, Warren L.—NY
Prideaux, Donald G.—SC
Prince, Sidney W.—BUF
Prindle, Don G.—CHI
Prior, James C.—SC
Pritchard, Hiram B. III—RO
Probst, Karl J.—NWK
Prosen, Stanley P.—BW
Proske, Herbert—NY
Prpich, George—DET
Pruitt, Julian S.—DET
Prutton, C. F.—BW
Pschorr, Frank E.—PH
Puderbaugh, George—BI
Pueser, Stanley W.—SL
Pullan, E. M.—ONT
Puls, Fred H.—MIL
Punnett, William M.—PH
Purdie, David—ONT
Purdue, John C.—TO
Putsey, Harold B.—SC
Pyhel, Henry—NWK
Pyle, Charles B. Jr.—CHI
Pyves, Edward L.—QUE

Q

Qually, Lloyd E.—CHI
Quarnstrom, Ivar—DET
Quartarone, Frederick P.—ENE
Quasnosky, Bert C.—NWK
Quear, Eugene C.—CI
Queisser, Arthur J.—CHI
Quinby, Frank L. Jr.—NWK
Quinlan, Joseph—NY
Quinn, Francis S.—NWK
Quinn, James P.—NWP
Quinty, Joseph E.—NWK
Quitoni, Louis J.—NWK

R

Rackett, William D.—CO
Rackow, John L.—CHI
Radel, William—PH
Rademacher, George A.—CHI
Rader, John—NY
Radi, Lino J.—NWK
Radler, Herbert W.—CI
Radler, Raymond W.—CI
Rae, Elmer—SC
Rae, James F.—GG
Raeuber, Arthur E.—MIL
Raff, Herbert L.—NY
Rafstedt, Richard E.—PH
Ragsdale, James W.—ST
Rahm, Louis F.—NWK
Rahm, Walter E.—NWK
Rahn, Arthur—ONT
Raiche, Arthur J.—CHI
Rainer, William C.—BW
Rainey, William J.—NWK
Rainhart, LeRoy G.—NS
Rainville, Arthur D.—SC
Rainville, Dewey—NY
Rakas, N. J.—DET
Rampe, John F.—CA
Ramsey, A. L.—CHI
Ramthun, Bruno—CHI
Randell, Arthur—SEO
Randolph, Harmon H.—NY
Rank, Charles—CHI
Ransburg, Stephen D.—CI
Rapata, George M.—CHI
Raskin, Betty Lou—BW
Rath, B. J.—DET
Raven, John E.—PH
Ray, A. A.—SC
Ray, Robert W.—MIL
Raymond, Kenneth W.—SC
Raymond, Loren T.—DET
Raymond, Roy D.—CHI
Raymond, S. W.—WNE
Rea, Bruce A.—CA
Rea, Robert G.—ONT
Reardon, Gerald V.—ENE
Reber, C. G.—WNE
Rebmann, Adolph—DET
Recchia, Orlando R.—RSM
Rector, Clinton—BW
Redford, William H.—ENE
Redgate, George M.—NWK
Redman, John—KC
Redmond, Floyd C.—RO
Redpath, James D.—ONT
Redwine, Edgar O.—SS
Reed, Amond O.—KC
Reed, George H.—NWK
Reed, George T.—NWK
Reed, John J.—NWK
Reed, Parker C.—ENE
Reed, William M.—SC
Reedy, William T.—PH
Rees, Wilbert J.—PI
Reese, Edwin P.—NWK
Reese, Robert C.—RO
Reib, John C.—NWP
Reich, Charles F., Jr.—CT

Reichel, Joseph J.—CA
Reiling, Victor G.—MV
Reinecke, J. O.—CHI
Reinhardt, George—CO
Reinhart, Frank W.—BW
Reinicke, Kurt B.—DET
Reinsmith, Gerald—BW
Reisert, A. Daniel—SL
Reising, Val O.—CHI
Reiss, Herbert—ONT
Reitmaier, John R.—NWK
Remley, J. W.—CI
Renner, Lynn J.—SL
Resnex, David L.—NY
Rettberg, Leonard—CA
Reutern, Eric—CA
Reveri, Erwin—SS
Rex, James S.—PH
Rexer, Alfred T.—NWK
Reybold, William U., Jr.—PH
Reyburn, Nathaniel—NWP
Reynales, Carols H.—SC
Reynolds, Edward P.—CI
Reynolds, Francis W.—BI
Reynolds, J. L.—CHI
Reynolds, M. Lester—CI
Reynolds, Robert E.—CHI
Reznik, Joe H.—SS
Rhein, Joseph P.—NWK
Rhine, Charles E.—CT
Rhine, George W.—CT
Rhodes, Michael S.—NY
Rhodes, Paul H.—KI
Rhodes, Philip H.—MV
Rhodes, William S.—SC
Rice, George H.—NY
Richards, Alan G.—CHI
Richards, Laurance H.—NWK
Richards, Percy A.—SC
Richards, Raymond A.—DET
Richards, Roger G.—CA
Richards, T. E.—CHI
Richardson, Edward C.—ENE
Richardson, Francis B.—NWP
Richardson, J. Wilfred—GG
Richarson, Henry M.—WNE
Richmond, Earl B.—WNE
Richter, Winston H.—CHI
Rickenbacher, R. J.—CA
Rider, Donald E.—QUE
Rie, John L.—NY
Rieder, George H.—NWK
Rielly, Francis J.—NWK
Ries, Kernell G.—BUF
Riggs, Horace S.—RSM
Riggs, Ralph—SC
Rightmyer, Harold A.—MV
Riley, Harold G., Jr.—CI
Riley, Malcolm W.—NY
Riley, Matthew H.—ENE
Rilling, Chester H.—NWP
Rinaldi, James D.—NWK
Ringel, Samuel—WNE
Ringwood, Arthur F.—NS
Ripkey, Harry A.—PHIL
Rissman, Otto—DET
Ritholz, Milton—NY
Ritt, P. E.—BW
Rizzo, Albert—PH
Rizzo, Bart—RSM
Rizzo, Peter J.—NY
Roach, James F.—CHI
Roach, Richard J., Jr.—CHI
Robb, John G.—GG
Robb, Phil F.—NY
Robb, Tom H., Jr.—ST
Robb, Wayne F.—RM
Robbers, Louis J.—MIL
Robbins, Burton B.—NY
Robbins, Kenneth O.—CHI
Robbins, Louis—RSM
Robbins, Max B.—CHI
Robbins, William G.—PV
Robert, Albert F.—RSM
Roberts, Edward B.—ENE
Roberts, Edward H.—KI
Roberts, Kenneth G.—NY
Roberts, Nelson F.—PH
Roberts, Robert E.—CT
Robertson, Bruce A.—PV
Robertson, Eugene N.—PH
Robertson, H. J.—ONT
Robertson, Ian—NWK
Robertson, Joe D.—SS
Robertson, Seymour M.—PI
Robinson, Clifford B.—CT
Robinson, Irwin H.—NY
Robinson, J. D.—CA
Robinson, J. Wm.—QUE
Robinson, Raymond E.—ONT
Robinson, Ronald G.—ONT
Robinson, Warren E.—BUF
Robinson, William H.—MV
Robison, C. Forbes—WNE
Robnett, Edwin H.—CA
Roca, Jose Colome—NS
Roche, Alfred J.—KI
Roche, Paul C.—NWP
Rodde, Arnold L.—CT
Roddy, Fred M.—RSM
Rodgers, Edward H.—GG
Rodgers, James S.—DET
Rodgers, William C.—NWK
Rodriguez, Andre B.—ENE
Rodts, Peter E.—NWP
Roe, Harry R.—PH
Roeck, Eugene C.—BUF
Roedel, Milton J.—PH
Rogan, Edward—CHI
Rogan, Julian J.—CHI
Rogan, Nicholas A.—MIL
Rogers, Joseph C.—NWK
Roggi, Porfirio E.—ENE
Rogow, Charles M.—NY
Roher, William C., Jr.—NY
Rohlfing, Ralph W.—CA
Rohn, Abbott M.—DET
Rohrbaugh, Frank—RO
Rohrer, Karl R.—CA
Rollins, Gordon C.—SS
Rollins, Vernon C.—GG
Roman, Harold G.—WNE
Romanowski, Henry J.—NWK
Rome, David—SC
Romo, Robert—GG
Roode, Melvin V.—MV
Roop, Nathan—CO
Root, William L., Jr.—ENE
Rosato, Dominick V.—PH
Rose, Edward I.—RSM
Rose, Elwood A.—ST
Rose, Henry M.—CA
Rose, John F.—UMW
Rosen, Samuel—RSM
Rosenberg, Abraham—NY
Rosenberg, Albert—NY
Rosenberg, Edward R.—NI
Rosenberg, Herbert H.—ENE
Rosenberg, Joseph H.—NY
Rosenberg, Philip—NY
Rosenberg, Ross—NY
Rosenberger, Frank B.—TO
Rosenheim, David J.—NWK
Rosenlund, Victor E.—WNE
Rosensaft, Melvin—NY
Rosenson, Jay H.—PH
Rosenthal, Alfred A.—NY
Rosenthal, Waldemar A.—MIL
Rosis, Constantine—WNE
Rosley, Howard A.—CHI
Ross, Alexander—NY
Ross, Arthur I.—ENE
Ross, Eric F.—NWK
Ross, Jesse—NY
Ross, Milton—PH
Rosser, Charles M.—PH
Rossner, A. G.—ENE
Roth, Eric M.—ONT
Roth, Merrill R.—PNW
Rothauser, Charles—NS
Rothenstein, Guy G.—NY
Rougemont, R. Louis—PV
Rounkles, Casey G.—KC
Rouse, Ben P., Jr.—SS
Rouzer, K. A.—CHI
Rowan, Edward W.—NWK
Rowe, Leif A.—CHI
Rowe, Wilfrid—CA
Rowland, Gilbert F.—DET
Rubin, Arthur R.—NY
Rubin, Ernest—SS
Rubin, Irvin I.—NY
Rubin, Richard L.—CA
Ruble, George E.—UMW
Rucker, Nancy W.—BW
Ruderman, Edward M.—PV
Ruderman, Theodore H.—PV
Rudish, Emil G.—DET
Rudolph, Ralph H.—UMW
Ruekberg, H. S.—CHI
Rugg, Gerard B.—NI
Ruggles, F. M.—CHI
Rundgren, Nels E.—CHI
Runfola, Christy J.—NY
Runge, Carl A.—CHI
Ruschman, Gordon A.—CHI
Rushmer, Ralph H.—BUF
Russell, Earl A.—BUF
Russell, Harry A.—NY
Russell, John L.—MV
Russell, Paul E.—MIL
Russell, Samuel—MV
Russell, Wyllys—NWP
Russo, Robert—PH
Rust, Henry R.—SL
Rust, Walter W.—PNW
Rutherford, Albert D., Jr.—BW
Rutherford, John B.—CI
Rutherford, John B.—CO
Rutland, Samuel F., Jr.—SS
Rutledge, James F.—PV
Ruttle, Joseph—DET
Ryan, E. N.—NWK
Ryan, Joseph D.—TO
Ryan, Thomas A.—CT
Rybak, Richard A.—CA
Rycyk, P. Edward—NWK
Rydelek, Frank A.—BI
Ryk, Frank—NWK

S

Sabary, Victor E., Jr.—NY
Sable, George S.—UMW
Sabo, John H.—GG
Sabo, Walter A.—CHI
Sacher, Alex—NY
Sackett, Robert D.—WNE
Sackrison, Arthur W.—UMW
Sadick, Louis—CT
Sadick, M. Michael—RSM
Safianoff, Albert—CHI
Sahagian, Sahag—RSM
St. James, C. Thomas—RSM
St. John, Randolph—RO
St. Lawrence, Albert—RSM
Sala, Arnold—NWK
Salad, Harry—NY
Salata, John—NY
Sale, J. W.—CI
Salevid, Ingemar—NS
Saller, Frank—MIL
Sallese, Vincent N.—NY
Salzinger, Samson G.—GG
Samelson, Lincoln R.—CHI
Sampson, Ronald N.—PI
Sandahl, Russell A.—RSM
Sandberg, K. O. William—CHI
Sanders, Milton A.—NWK
Sanders, Philip H.—CHI
Sandler, Jack—NWK
Sandow, Kiyoshi—ST
Sangerman, M. R.—CHI
Sansum, John D.—ONT
Santelli, Thomas R.—TO
Sapery, Stanley—NY

Sargent, John W.—MIL
Satterthwaite, Arlo D.—CI
Sauerman, Jack E.—NWK
Saurwein, Clifford F.—CA
Savage, James H.—CT
Savage, Richard J.—NWK
Savitt, Kenneth—NWK
Sawdey, Roland S.—DET
Sax, Henry—NY
Sayek, Henry M.—NWK
Saylor, Richard E.—NY
Sbar, Moses—NY
Scales, George M.—PH
Scalise, Richard—CT
Scanlon, Edward C.—RSM
Scantlebury, Clifford V.—NWP
Scapicchio, Anthony J.—ENE
Scarito, Philip R.—NWK
Scavuzzo, John J.—NWK
Schaaf, Paul H., Jr.—NWK
Schacht, Reimer—PH
Schaefer, Carl—CT
Schaefer, James M.—KC
Schalin, Edmund—MIL
Scharnberg, John—CHI
Schatz, Ernest A.—ENE
Schatz, Joel—NY
Schaub, Thomas F.—SC
Schaul, J. S., Jr.—NWK
Scheer, Harry—CHI
Scheidl, John—NY
Scheidt, Theodore W.—NWK
Scheirer, Thomas J.—PH
Schenck, Harry, Jr.—MV
Schenkman, Jack—NWK
Scherry, George A.—CHI
Scheuer, George J.—ENE
Schick, Harold P.—CA
Schiff, Charles—CHI
Schiff, Leonard—NY
Schiller, Julius M.—NWK
Schilling, Paul K.—UMW
Schimmel, Milton T.—SC
Schini, Carl—CI
Schirmer, Max—ENE
Schlager, Wilfred C.—CHI
Schlang, Edwin A.—NY
Schleiter, Robert F.—CHI
Schliem, Richard H.—CHI
Schlussman, Gilbert—CHI
Schmanski, Donald W.—UMW
Schmeling, K. E.—UMW
Schmelter, Gordon P.—CA
Schmey, Paul—NWK
Schmid, William—TO
Schmidt, Jack W.—NY
Schmidt, Joseph J.—CHI
Schmidt, Paul E.—NWK
Schmidt, Robert L.—CHI
Schmitt, Arthur J.—MIL
Schmitt, Joseph B.—PI
Schmitz, Carl E.—CHI
Schnapf, Fred H.—KI
Schneble, Frederick W., Jr.—NY
Schneider, Albert J.—WNE
Schneider, Frederick W.—PH
Schneider, Joseph F.—SC
Schneider, Kurt A.—CT
Schneider, Myles Z.—NY
Schneider, Robert—SC
Schneller, Rudy F.—SL
Schner, Charles, Jr.—NY
Schnitzius, Homer D.—CI
Schnopp, David P.—RSM
Schnorr, William J.—SC
Schobert, Wm. B., Jr.—PHIL
Schoeller, Russell E.—CHI
Schoenau, Henry—NY
Schoeneberg, J. Carl—SL
Schoenfield, Herbert—CHI
Scholler, Robert W.—SC
Schopflin, William—KC
Schor, Harold—NY
Schotland, Murray—NY
Schrag, Wayne M.—NWK
Schramm, Roy L.—CHI
Schreiner, Edward P.—SC
Schreiter, Fred R.—PV
Schrenk, Ernst—NS
Schriber, Carter P.—GG
Schroder, Arthur—BW
Schroeder, Wesley D.—PI
Schroeter, E. K.—CHI
Schuck, Julius J.—ONT
Schule, Elmer C.—NWK
Schultz, George W.—PHIL
Schultz, Robert S.—NWK
Schulz, Richard O.—CHI
Schulze, Kurt E.—GG
Schumacher, Elmer F.—PH
Schuster, George J.—NWK
Schutz, Frank C.—PH
Schwab, Ernest G.—PH
Schwab, Fred E.—DET
Schwan, Willis L.—UMW
Schwartz, Arnold J.—CA
Schwartz, Harold H.—NY
Schwartz, Jerome E.—CT
Schwartz, Martin W.—NY
Schwartz, William—CA
Schwartz, William C.—SS
Schwartz, William H.—CA
Schwarz, Herbert F.—CHI
Schweitzer, Lawrence—NY
Schweitzer, Richard H., III—CI
Schwing, John J.—RSM
Scofield, Clem F.—NY
Scogin, Robert J.—SS
Scott, C. Rex—PV
Scott, G. Murray—ONT
Scott, Talmadge L.—SEO
Scott, Thomas S.—MV
Scribner, George K.—NWK
Scudder, Nathan F.—SC
Scutt, Arthur G.—BUF
Seanor, R. E.—CA
Searles, William L.—CT
Seavey, Fred R.—SL
Seay, Charles L.—ONT
Seborowsky, Frank E.—NY
Secreto, Albert—NY
Segal, Max—SC
Segner, C. D.—CA
Seidl, Frank P.—UMW
Seiler, William F.—PI
Seith, Robert T.—MIL
Seitz, Edward F., Jr.—NWK
Sekowski, John L.—CHI
Seley, Sidney C.—NWP
Sell, John M.—CI
Self, M. A.—CHI
Selig, Allan H.—NY
Selz, Charles M.—MV
Semeyn, Don B.—DET
Senn, Richard K.—CA
Serle, Allan G.—NWK
Serrell, Victor E.—RO
Serrick, R. L.—TO
Setter, Donald E.—KC
Seubert, Robert F.—NY
Severs, Edward T.—NWK
Seymour, Desmond G.—ONT
Seymour, Dexter—ENE
Seymour, Raymond B.—PH
Shaeffer, Donald E.—CA
Shafer, Chas. F.—NI
Shaffer, Abe—NY
Shaffer, H. S.—MV
Shaines, Alfred—ENE
Shanly, John S.—NWK
Shannon, John W.—CHI
Shanok, Jesse P.—NY
Shanta, Charles—PI
Shanta, Peter L.—BUF
Shapero, Wallace H.—CHI
Sharbaugh, James—SL
Sharland, Richard H.—RSM
Sharp, John C.—CHI
Sharp, Leslie P.—CA
Sharp, T. W.—NY
Sharp, Warren A.—CT
Sharpe, David—ENE
Sharpe, Leslie P.—CA
Shastal, Eugene D.—CHI
Shaw, Fred B., Jr.—MIL
Shaw, George E.—NWP
Shaw, Martin L., Jr.—PH
Shaw, Stanford H.—NWK
Shaw, Sydney—ONT
Shaw, Victor—CO
Shay, Phil—ST
Shearer, Wendell B.—MV
Sheedy, Thomas J.—WNE
Sheehan, E. T.—RSM
Sheffer, James B., Jr.—PH
Sheftel, Milton S.—PV
Shehan, Leslie J.—ONT
Shelton, John A.—SC
Shepardson, Wilfred B.—QUE
Shepherd, Irving L.—CA
Sheridan, David S.—NY
Sherman, A. C.—PNW
Sherman, Edward R.—CT
Sherman, Jack—NY
Sherman, Jay D.—NWK
Sherman, Max R.—NWK
Sherman, Norman G.—ST
Sherman, Robert W.—NY
Sherwin, William R.—PI
Sherwood, Miller G.—DET
Shevett, Robert—NY
Shiffman, Jerome—NY
Shimada, Yoshihide—OSA
Shine, William M—NY
Shirk, Raymond A.—RO
Shirley, Granville H.—CA
Shlafmitz, Abe—NY
Shluger, George—NY
Shnier, J. Philip—ONT
Shoemaker, Chester S.—PH
Shorey, Seth U.—ENE
Short, Howard E.—MV
Short, William L.—KC
Shrontz, John W.—CA
Shuey, Ralph C.—GG
Shugars, Henry E.—CHI
Shultz, Carl E.—DET
Shulver, Fred J.—DET
Shunaman, Albert—WNE
Shusman, Tevis—WNE
Sibalis, Jack—QUE
Siddall, Don F.—CA
Sido, G. Robert—BW
Sidun, Cyril—NWK
Siefert, R. F.—CI
Siegel, Herman M.—NY
Siegel, Phillip M.—CHI
Siegmund, Harold K.—NWP
Sieminski, Leonard S.—NI
Siers, Leo J.—PNW
Siesky, Roy A.—KI
Silas, Cecil J.—KC
Silberberg, Melvin—PV
Silberkraus, Sam—SC
Silling, C. E., Jr.—PH
Sills, M. J.—NWK
Silovich, Martin—DET
Silva, Victor—RSM
Silver, Irving—BW
Silver, Joseph R.—CA
Silverman, R. B.—CHI
Silversher, Herman I.—SC
Silverstein, S. M.—WNE
Silverzweig, Julius—NY
Sim, Alan A.—NWP
Simmons, Aldred J.—MIL
Simmons, Peter W.—NWK
Simon, Alfred L.—ENE
Simon, Leonard—NY
Simon, Sylvan S.—NY
Simonds, Herbert R.—CT
Simons, Henry N.—NY
Simpson, Jack N.—PH
Simpson, James E.—CA
Simpson, Ralph S.—CI
Sindars, Fred E.—SC
Sindel, Howard B.—NY
Singer, Edward—CHI
Singer, Eugene J.—NY

Singley, J. E.—SS
Sinitsin, V. W.—PNW
Sipe, Jones P.—SS
Sisson, James B.—NY
Sjolander, John R.—UMW
Skeels, Arthur N.—NWK
Skeist, Irving—NWK
Skelly, James, Jr.—PH
Skelton, Owen E.—CHI
Skidmore, Richard H.—PH
Skidmore, Russell H.—NY
Skinner, Harvey G.—PI
Skoog, Donn E.—DET
Skorupa, Bernard J.—CHI
Skov, Robert L.—GG
Skow, Norman A.—PH
Skutch, W. G.—TO
Skutch, William G., Jr.—TO
Slack, James W., Jr.—KI
Slaght, Emery B.—BI
Slate, James M.—SC
Slater, John G.—DET
Slavin, Frank E.—CHI
Slingluff, Eugene—MIL
Slipp, Roy M.—RSM
Sloan, Jack—NWK
Sloane, David J.—CA
Sloane, Gerard H.—NY
Sloane, John R.—RSM
Sloat, John E.—WNE
Slobodzinski, Adolph E.—NY
Smack, Kenneth G.—NWK
Smenner, Roland F.—NI
Smigelski, Gerald G.—DET
Smith, Alex—TO
Smith, Allen B.—NY
Smith, Arthur E.—NY
Smith, Arthur L.—PH
Smith, C. Earl—CI
Smith, Clifford R.—CI
Smith, Donald F.—NWK
Smith, Donald L.—BI
Smith, E. E.—PH
Smith, F. Edward—CA
Smith, Francis K.—CT
Smith, Fred H.—PH
Smith, George D.—WNE
Smith, George S.—CA
Smith, Harold A.—RM
Smith, Herbert A. T.—NWK
Smith, James C.—GG
Smith, James V.—KC
Smith, Joe B.—GG
Smith, John A.—PH
Smith, John M.—MIL
Smith, J. Quentin—NI
Smith, Laurence F.—DET
Smith, Marshall O.—CHI
Smith, Orville W.—CHI
Smith, Paul M.—SEO
Smith, R. Moen—PH
Smith, Richard A.—NWK
Smith, Richard P.—CHI
Smith, Robert M.—TO
Smith, Robroy A.—DET
Smith, Roger, Jr.—ST
Smith, Roy A.—DET
Smith, S. J.—NY
Smith, W. Mayo—ENE
Smith, Walter F., Jr.—NWK
Smith, Walter J.—PH
Smith, Walter R.—ENE
Smith, William F.—ST
Smith, William H.—CT
Smith, William M.—CA
Smith, William M.—ENE
Smith, Williard K.—CA
Smolenski, Wilfried H.—CI
Smolka, George—NY
Smoluk, George R.—NWK
Snell, Robert H.—BUF
Snyder, Charles J.—PI
Snyder, Direk—DET
Snyder, Eugene H.—CO
Soderberg, Eric W.—CT
Sofro, Louis J.—RSM
Soifer, John R.—NS
Sokol, Benjamin—NY
Sollenberger, George H.—PI
Solop, Eli—CA
Somers, J. F.—WNE
Sommers, K. A.—CHI
Soncrant, Donald T.—TO
Sordillo, Vincent F.—WNE
Sorensen, Frederick H.—CT
Sorensen, Harold—PH
Sorg, E. H.—NWK
Soules, E. B.—NWK
Sovia, Cedric C.—UMW
Spaak, Albert—NWK
Spacciapoli, Americo P.—PV
Spagnoli, Patsy I.—CHI
Spalding, Samuel C., Jr.—KI
Spalter, Leo—NY
Sparrow, Lawrence R.—NY
Spaulding, Eugene O.—TO
Specht, Edward A.—PI
Specktor, Leon H.—SC
Speicher, Charles L.—NI
Speier, Albert K.—NY
Speight, Frank Y.—PH
Spencer, Charles D.—NWK
Spencer, Harvey G.—SC
Spencer, Murray G.—ONT
Sperber, Meyer—PH
Speth, Hugo H.—SL
Spidle, Larry L.—SL
Spielman, Harry R.—CHI
Spielman, Simon S.—NY
Spillman, Kenneth W.—SC
Spinelli, Paul A.—BI
Spink, Peter W.—SL
Spinks, Frank L.—ONT
Spirer, Irvin E.—PH
Spires, Harold S.—MV
Spitzer, Carl J.—BI
Spitzig, Edmund W.—NWK
Spitznagel, John F.—RO
Spivak, Sidney G.—CHI
Spiwak, Lazarus—WNE
Spodnyak, Paul—CHI
Spokes, Ray E.—DET
Sporing, William F.—NY
Sprague, W. A.—ONT
Sprankle, Cortes N.—WNE
Spransy, George B.—MIL
Sprung, John G.—SC
Squires, W. Kenneth—PI
Staab, George J.—NWK
Stabler, Robert E.—PH
Stackhouse, Donald F.—PI
Stadtherr, Nicholas G.—PV
Stadtler, Walter A.—NY
Staff, Arthur A.—WNE
Stafford, Thomas P.—GG
Stahlberg, Eric, Jr.—WNE
Stahlberg, Paul—WNE
Stahmann, John A.—SC
Stalbaum, Ralph H.—NWK
Stander, Maxwell—BW
Stanford, Jerome S.—BUF
Stange, Walter H.—CHI
Stanhope, Russell C.—DET
Stanley, Donald—KC
Stanley, Fred B.—NWK
Stannett, V. T.—RO
Stansbury, John G.—SC
Stansel, J. C.—SEO
Stanton, John L.—NWK
Starck, Richard—MIL
Starin, J. A.—NY
Stark, Walter M.—DET
Stecca, Lt. Eugene A.—PHIL
Stecker, Fred—NY
Steele, Harry V.—RO
Steele, Roger C.—GG
Steere, Frank W., Jr.—CA
Stehowsky, William E.—CI
Stein, A. B.—QUE
Stein, George A.—MIL
Stein, Sidney J.—PH
Steinberg, Albert H.—SEO
Steiner, Frank A.—SC
Steiner, Phillip L.—NY
Steinhardt, I. Hartley—NWK
Steinman, Robert—SC
Stellings, Donald A.—ONT
Stenberg, John B.—RSM
Stenberg, K. E. Birger—RSM
Stenersen, Arnold A.—UMW
Stephen, George W.—ONT
Stephens, James H.—UMW
Stephens, William J., Jr.—SL
Stern, J. J.—NWK
Steubner, J. C.—CHI
Steuer, Egon—NWK
Stevens, J. Murray—ENE
Stevens, Robert G.—CHI
Stevens, William G.—DET
Stevenson, Howard S.—PH
Stewart, Bruce J.—PNW
Stewart, Carroll E.—BW
Stewart, James H.—WNE
Stewart, James M.—NWK
Stewart, Joe W.—MIL
Stewart, John W.—ENE
Stewart, Robert B.—GG
Stewart, Ross E.—CA
Stickel, Wesley N.—WNE
Stickles, Donald C.—ENE
Stiegler, Frederic L.—PH
Still, Hobart T.—BUF
Still, Palmer—SL
Stilwell, William M., III—NY
Stimpson, G. E. T.—NS
Stine, Herbert C.—NWK
Stiratelli, B. A.—CA
Stirrat, John R.—WNE
Stivala, Salvatore—NWK
Stocker, Lorne C., Jr.—BW
Stockton, Richard E.—MV
Stoeckhert, Klaus—NS
Stoeffhaas, Walter H.—CHI
Stoesser, M. J.—ONT
Stoffel, Frank J.—NI
Stokes, Jerry C.—NWP
Stokes, W. J. D., II—NWK
Stomp, Alvin N.—DET
Stone, Sam J.—CHI
Stopek, Benjamin—NY
Storey, James—QUE
Storin, Gordon K.—BUF
Stose, Harold F.—ENE
Stott, Harry S.—PH
Stott, Richard F.—NY
Stover, Harold R.—WNE
Stover, Robert R.—SL
Stowarz, Terry C.—NWK
Stowe, Clarence H.—MIL
Stowe, Marvin C.—MIL
Strain, Daniel E.—PH
Stranathan, William J.—SEO
Strand, Robert C.—BUF
Stratton, Edward B., Jr.—CT
Strauss, Eric L.—BW
Strauss, Robert G.—WNE
Strauss, William—PH
Street, Louis F.—PH
Stregack, B. Martin—NY
Streifer, Herbert—NY
Stringfield, Raymond E.—SC
Strobel, Joseph J.—BW
Strobino, Frank L.—MV
Strom, William T.—MV
Stroman, Robert M.—RO
Stromberg, Robert R.—BW
Strong, Casper—MIL
Strong, Richard V. D.—PH
Strong, Robert H.—ONT
Strully, Herman—NY
Struthers, A. W.—DET
Stryker, Charles S.—NY
Stuart, A. M.—ONT
Stubbe, Paul L.—NWP
Stukaloff, Lester C.—SC
Sturken, Robert C.—NWK
Stuver, Chester F.—PI
Suba, Michael M.—RSM

Sucher, Joseph—NY
Suchocki, Edward—CHI
Suer, Donald—MV
Sugar, David K.—ONT
Suiter, William A.—MV
Suleski, Richard R.—RSM
Suleski, Robert F.—RSM
Sullivan, Charles J.—CT
Sullivan, Gerald S.—NWK
Sullivan, Joseph T.—PH
Sullivan, Laurence E.—BW
Sullivan, Leo P.—UMW
Sullivan, Michael W.—NWK
Sullivan, Richard X., Jr.—DET
Sultany, Steven J.—UMW
Summers, Ernest R.—CHI
Summers, Kenneth R.—SL
Sumner, Earl C.—MV
Sumner, Kingsley E.—WNE
Sundberg, Carl W.—DET
Sunderland, George B.—CT
Sundstrom, Gunnar—NWK
Sundstrom, John F.—CI
Supliski, Otto J., Jr.—NY
Supnik, Ross H.—PV
Sussman, Vincent—NY
Suter, Ernest P.—QUE
Sutro, F. C., Jr.—KC
Svabek, John E., Jr.—CHI
Svenson, Sven C.—CT
Swackhamer, Farris S. J.—NY
Swafford, Joseph S.—SL
Swain, Alvan E.—PH
Swain, Robert D.—BW
Swan, Wilbur M.—CHI
Swanson, Frank O.—CT
Swart, Gilbert H.—CA
Swartz, C. Kenneth—NWK
Swartz, Wilfred R.—SC
Swartzbaugh, Peter T.—TO
Sweaney, Robert W.—CA
Sweeney, Edward J.—WNE
Sweeney, John J.—NWK
Sweeney, Joseph P.—BW
Sweet, William R.—PH
Swenson, Victor H., Jr.—NWK
Swift, Gordon S.—WNE
Swift, L. J.—CHI
Swift, Lester L.—CA
Sworen, William—NWK
Sykes, Robert M.—NS
Sykes, Walter—PH
Symanski, Edward—BI
Symkowski, Edward—MIL
Symons, Ralph B.—RSM
Szabo, Paul C.—CA
Szajna, John L.—CHI
Szantay, Elmer—CHI
Szantay, Violet—CHI
Szarawarski, Chester—NWK
Szpila, Jerome S.—PH

T

Tabor, Carl J.—SL
Tagas, Howard J.—PNW
Tait, Guy H.—SC
Talbert, Norbert E.—NY
Tallman, Louis E.—SC
Talmadge, George C.—CA
Tanenbaum, Ely—NY
Tanis, Edward—NWK
Tanner, Glenn A.—RSM
Tanner, Walter J.—NY
Taplin, Thomas E.—RM
Tash, Sam—SC
Tates, Chester R.—BW
Tatter, John W.—DET
Tauchin, Joseph—NY
Taylor, Bert S.—CO
Taylor, George M.—DET
Taylor, James J.—ONT
Taylor, John S.—PH
Taylor, N. C.—CA
Taylor, Richard G.—PH
Taylor, Wallace L.—KI
Teagarden, John E.—PH
Tefft, Erwing W.—RSM
Telson, Eric E.—NY
Temple, William M.—BW
Tenebaum, M. R.—DET
Tenney, Howard A.—NY
Teplansky, George J.—CA
Terbrack, John C.—CA
Ter Horst, W. P.—BW
Terpak, Anthony—RSM
Testolin, R. J.—CI
Teves, Fred W.—CA
Thal, Bernard—ENE
Thayer, Gordon B.—DET
Thayer, Richard I.—ENE
Thayer, Warren P. Jr.—CI
Theis, Robert E.—CHI
Theiss, Roy E.—GG
Theodore, Michael—PI
Therrien, Alfred L.—RO
Thews, Richard M.—NY
Thiel, Fred E.—NY
Thielen, Albert F. Jr.—PH
Thies, L. P.—CA
Thilk, Ransom D.—BUF
Thomann, Edward—SL
Thomas, Arthur Jr.—SL
Thomas, Arthur W.—PV
Thomas, Charles W.—PH
Thomas, Islyn—NWK
Thomas, John G.—NWK
Thomas, Paul E.—PH
Thome, J. S.—PH
Thompson, Albert C.—GG
Thompson, Auburn V.—PH
Thompson, Barton H.—SC
Thompson, D. M.—CHI
Thompson, Elmer G.—CO
Thompson, Howard D.—BUF
Thompson, John G.—PV
Thompson, John P.—CA
Thompson, Leslie F.—CHI
Thompson, Wallace B., Jr.—PH
Thomson, James A.—NWK
Thomson, Richard K.—PV
Thomson, Robert—KC
Thoreson, Reider—DET
Thornburg, David W.—NWK
Thornhill, Wm. S.—NY
Thornley, Robert W.—RSM
Thornwald, Everett D.—CHI
Thrash, David J.—PI
Threlkeld, D. S.—MV
Throckmorton, Peter E.—UMW
Thuemmler, Rudolph W.—DET
Thurmond, Charles D.—SC
Tice, Clarence E.—CI
Tickner, E. C.—NWK
Tietz, Paul C.—CHI
Tigner, Robert E.—NWK
Tilbrook, Kenneth B.—KC
Tiley, Raymond A.—PH
Tills, Paul—MIL
Tilp, Robert F.—NWK
Timpf, Henry C.—NWK
Tinkham, Sumner E.—NWK
Tirpak, Francis M.—NWP
Tisch, Henry A.—NWK
Tiso, John E.—NY
Todd, Arthur W.—CA
Todd, William D.—CA
Toepel, Walter A.—NY
Tolbert, Wm. P. Jr.—CHI
Tomaszewski, Alfred—TO
Tomb, Hugh M.—ENE
Tomford, Harry C.—NY
Tomkin, David—BW
Tooker, K. O.—PI
Tope, Raymond S.—CO
Torau, Gunther W.—NWK
Tordi, Ray—CA
Tornberg, Ingvar E.—NWK
Toth, Joseph—MIL
Totten, John K.—GG
Touchette, Norman W.—SL
Towler, David W.—ENE
Towne, Carl A.—CA
Towsley, Frank E.—DET
Tracy, Henry J.—NY
Trafford, Arthur L.—ONT
Traflet, Frederick E.—NY
Trautweiler, Winifield J.—NWK
Travis, Gordon K.—NY
Treer, R. B.—CA
Trembley, John F.—WNE
Tresemer, Howard G.—CHI
Tress, John J.—PI
Triano, P. N.—NWK
Tripp, Alonzo J.—DET
Tripp, R. A.—QUE
Troester, Fred W.—SC
Trombetta, Ben J.—PH
Troy, Arnold—CT
Troyan, James E.—CT
Trudeau, Rolland C.—WNE
Truitt, James P.—ENE
Trump, Don A.—CA
Trump, Elno H.—CA
Trunk, Eugene J.—CT
Tsang, Tung—UMW
Tucker, Walter G.—NWK
Tukdarian, Michael—NY
Tulley, Fred—CHI
Tullgren, Herbert A.—SC
Tupper, Frank H.—PH
Turkovich, Peter—GG
Turner, Fred—ONT
Turner, Howard M.—NI
Turner, J. O.—GG
Turner, Luther B.—NWK
Turrell, Merton R.—RO
Tuxson, R. O.—ST
Tyrrell, Frederick S.—NY
Tyrrell, William J.—NY
Tyson, Robert M.—CHI
Tytell, Boris H.—ENE

U

Uber, R. F.—KC
Ulbrich, M. Alfred—ENE
Ullman, Charles S.—NY
Ullman, J. O.—PH
Ulrich, Erwin W.—UMW
Ulrich, John—CHI
Underwood, Theodore A.—ENE
Underwood, William F.—CHI
Upton, F. B.—QUE
Urbach, Herman G.—PI
Urban, Richard E.—CHI
Urbanic, Anthony J.—CA
Ursem, Richard J.—CA
Usab, Martin—SC
Usandizaga, Eugenio—NS

V

Vacca, Andrew A.—SC
Vaccarello, Ray—SC
Vach, Joseph—NWK
Vaill, Edward W.—NY
Valchera, Serge C.—NS
Valentine, Alan T.—CA
Valentine, David C.—UMW
Valentine, John P.—BUF
Valentine, John R.—CT
Valentine, Michael R.—CT
Valentine, Roger E.—NI
Valka, Frank E.—DET
Vallee, Ernest L.—ENE
Vallieres, Armand—WNE
Valois, Maurice—QUE
Van Amberg, H. W.—DET
Van Buren, Darrell—ENE
Van Buren, Tracy H., Jr.—SS
Van Denburgh, L. W., Jr.—NWK

Vandenkerckhoven, William—RSM
Van Deventer, Christopher, III—DET
Van Duyne, Harrison N.—NWK
Van Epps, Clarence F.—RO
Van Geem, Richard—BUF
Van Horn, Richard—NY
Van Ness, Paul J.—NWK
Van Schoick, Ivan—DET
Van Sickle, Robert W.—ST
Van Winkle, E. F.—SC
Varela, Andrew A.—SC
Varie, Hamilton—PH
Varner, Arnold M.—KI
Vassar, Thomas E.—KI
Vaughan, Francis B.—PH
Vaupell, L. J., Jr.—PNW
Vawter, Will E.—BI
Velimesis, George S.—CI
Velleu, Richard B.—UMW
Vellinga, John—CHI
Venne, Joseph R.—BI
Ventuvelli, Vincent S.—RO
Verburg, John A.—MIL
Verdery, Roy B., Jr.—SL
Verdi, John M.—NWK
Verheul, Robert—DET
Versteeg, James H.—NY
Veverit, James V.—BUF
Vezzosi, Hugh—NWK
Vezzosi, Samuel D.—NWK
Viel, Arthur R.—CHI
Vines, George R.—MV
Virgin, Carl W.—CA
Visger, Ross D.—BUF
Visneski, Vern N.—UMW
Vitellaro, John J.—NY
Voegtlen, J. Martin—NY
Vondracek, Charles H.—PI
Von Doenhoff, Carl—BUF
Vogan, Thomas W.—PI
Vogel, John G.—WNE
Vogel, Walter G.—NY
Vogel, Woodrow J.—BW
Volkober, Louis V.—CHI
Vollertsen, John J.—RO
Volpini, Dante—BUF
Von Holdt, John W.—CHI
Von Toerne, Theodore R.—NWK
Voskamp, Henry A., Jr.—NWK
Voskian, Alfred A.—NY
Voss, A. H.—CI
Voss, Donald J.—PI
Vuksanovich, Mitchell—ST

W

Wade, Kenneth S. B.—NWK
Wadsworth, Richard C.—NY
Wadtke, George W.—DET
Wagner, Aaron P.—NWP
Wagner, Harold A.—PH
Wagner, N. H., III—PV
Wagner, Richard H.—RSM
Wagner, Ronald E.—TO
Wagner, V. S.—PH
Wahl, Norman E.—BUF
Wahl, Warren P.—CHI
Wakefield, Chester A.—NWP
Wakefield, Richard E. B.—PH
Walb, T. A.—NY
Waldon, Vernon L.—CI
Wales, Charles A., Jr.—ST
Walker, Benjamin M.—NWK
Walker, George A.—CT
Walker, George T.—CHI
Walker, J. Warren—ENE
Walker, Kenneth D., Jr.—PH
Walker, Robert L.—ST
Walker, Willard B.—NWP
Wallace, J. H.—ONT
Wallace, Lewis C.—BW
Wallestad, Victor—UMW
Walley, Don C.—SL
Wallis, Benedict L.—NY
Walsh, James A.—ONT
Walsh, Vincent E.—MV
Walsh, W. Richard—DET
Walster, Edward H.—NY
Walter, John, Sr.—ONT
Walters, Fred Y., Jr.—ONT
Walters, Harry E.—CHI
Walters, Linwood A.—PH
Waly, Adnan—NY
Wamsley, Starling—CI
Wanczuk, Edgar A.—SC
Wandschneider, Alfred W.—UMW
Wanner, Louis R.—NWP
Ward, Andrew Y.—PI
Ward, Frank F., CT
Ward, John A.—CHI
Ward, R. S.—ENE
Ward, Winslow A., III—NY
Wardle, Byron R.—NY
Wareham, William W.—NI
Ward, Robert S.—ENE
Wargo, Andrew J.—CT
Wargo, Lewis L.—PH
Warner, Jack C.—CA
Warner, Louis A.—CHI
Warnke, Harry D.—MIL
Warnock, Joseph R., Jr.—CHI
Warp, John R.—CHI
Warren, Robert K.—CT
Warriner, W. C.—PH
Wash, George—KC
Washburn, Earl F.—MIL
Washing, Ray R.—TO
Wasilewski, C. E.—NWK
Wasserman, Harold A.—NY
Watanabe, M.—OSA
Waterfield, C. F.—CA
Watkins, William B., Jr.—KI
Watkins, William H.—CHI
Watkins, Willis T.—KC
Watson, E. Ray—ONT
Watson, Harry E.—ONT
Watson, Stanley C.—UMW
Watson, Thomas E.—ENE
Watt, George A.—SC
Watts, Charles E.—SC
Waugh, Charles M.—CHI
Way, Robert B.—NWP
Waychoff, Walter F.—SL
Weaver, Alfred G.—PV
Weaver, Ebon P.—PH
Weaver, Miles A.—DET
Weaver, Philip J.—CA
Weaver, Wesley A.—MV
Weaver, Wiley H.—BW
Webb, Edward I.—NY
Webb, John A.—PHIL
Webb, Kermit M.—WNE
Webb, William Y.—BW
Webber, James B.—WNE
Weber, Carl E.—MV
Weber, Herbert—NY
Weber, Richard M.—GG
Weber, Robert G.—CO
Weber, Wesley E.—SC
Webster, C. R.—DET
Webster, Thomas, Jr.—CO
Weeks, Wilmot L.—PV
Weersing, Paul S.—PNW
Wegener, Francis A.—PH
Wehling, Stanley S.—BUF
Wehn, Charles E.—GG
Wehr, Henry W., Jr.—DET
Weichmann, Edmund G.—CHI
Weil, Alan L.—CA
Weinberg, Arthur M.—NY
Weinberg, Felix B.—BW
Weinberg, Mark H.—NWK
Weiner, Bernard—NY
Weinhart, Martin—CHI
Weinman, Herbert B.—CI
Weinraub, Herbert M.—NY
Weir, Clifford L.—NY
Weir, George W.—NY
Weirich, Wallace J.—CHI
Weisend, B. A.—CO
Weiskopf, B. Walter—NWP
Weiss, Hans K.—NY
Weiss, Jack—NY
Weiss, Milton—NWK
Weissenstein, Clarence H.—BW
Welch, Adrian—CA
Welch, Arthur R.—CO
Welch, Gerald J.—TO
Welch, Henry W.—PH
Welch, Kenneth B.—MIL
Welch, Lawrence E.—NWK
Welch, Raymond W.—CI
Welch, Richard E.—SS
Welch, William E.—WNE
Welling, Charles E.—DET
Welsh, Daniel G.—PH
Welsh, Thomas J., Jr.—NWK
Wendelken, Edward W.—SEO
Wenger, Earl C.—NWK
Wennerholm, Bjorn I.—NS
Wenninger, Bernard P.—BI
Werber, Walter E.—NWK
Werner, Albert G.—SL
Werner, Arnold C.—CT
Werner, Stanley—NY
Werner, W. A.—CHI
Werth, Frank C.—MIL
Weschler, Joseph R.—NWK
Wessinger, Bruno E.—NY
West, Charles P.—NWK
West, Paul A.—MIL
West, Richard K.—CHI
Westall, Edward B.—SC
Westergaard, Emil A.—CHI
Westhead, Andrew—BW
Weston, Keith A.—CI
Westover, R. F.—NWK
Westreich, Daniel—CHI
Wetty, R. Alvin—PH
Wetzel, Clayton S.—PH
Wexler, George J.—NY
Weygandt, John C.—CA
Weyrich, Arthur G.—CHI
Whalley, A. Grant—ONT
Wheeler, Albert I.—RSM
Wheeler, Clifford R.—WNE
Wheeler, James A.—CT
Wheeler, Kenneth A.—NWK
Wheeler, Peyton—NWK
Wheeler, Willard W., Jr.—SC
Wheeler, William T.—NY
Whetstone, James D.—CA
Whitacre, C. C.—CHI
Whitaker, J. Sam—NY
White, Alonzo, III—PH
White, Clarence W., Jr.—NY
White, Erven—SC
White, James C.—KI
White, James E.—CI
White, Joe P.—CHI
White, Marcus—NY
White, Quentin M.—PH
White, Robert A.—NWK
White, Robert P.—CT
Whited, Adrian W.—NY
Whitehead, George W.—WNE
Whitener, Ernest K., Jr.—NY
Whitescarver, Wilmer F.—NWK
Whitfield, James W.—BW
Whitlock, C. H.—DET
Whitlock, Huber M.—DET
Whitner, George A.—PH
Whitney, Alva E., Jr.—NWK
Whitney, Edgar H.—WNE
Whitney, William L., II—KC
Whitted, John B., Jr.—CHI
Whittles, George E.—CHI
Whitty, Wilbur H.—ENE
Wiberg, Nils I.—CT
Wiborg, James H.—PNW
Wickstrom, H. W.—NWK
Widlund, Ernest F.—DET
Wiedman, Charles T.—DET
Wiedmann, Carl M.—NWK
Wiese, William E.—WNE
Wieselmann, Egon W. G.—RM

Wiesner, Harold J.—MIL
Wiggins, Arthur J.—NWK
Wilcox, Grayson W.—CT
Wilds, R. W.—CI
Wiley, Fred E.—WNE
Wilker, Thomas A.—ST
Wilkins, Clyde, Jr.—SS
Wilkins, W. Burdette—NWK
Wilkinson, Freeman F.—ENE
Wilkinson, James R.—MIL
Wilkinson, Malcom—QUE
Wilkinson, Robert E.—CI
Wilkinson, Thomas B.—BUF
Will, Alphonse E.—WNE
Will, Roger R.—SL
Willenbrock, Karl H.—NWK
Willenbrock, William E.—NWK
Willert, William H.—NWK
Williams, Alfred E.—CA
Williams, Alfred J.—PH
Williams, Bill—CA
Williams, Charles A.—NWP
Williams, Charles J.—RO
Williams, Clark—KC
Williams, David—CA
Williams, D. R.—UMW
Williams, Donald W.—CA
Williams, F. A.—QUE
Williams, Fred P.—MV
Williams, Harold A.—UMW
Williams, Harry C., Jr.—SS
Williams, J. B.—SS
Williams, John G. E.—ONT
Williams, Leslie E.—SS
Williams, Lewis C.—ST
Williams, Lyle N.—CI
Williams, Mansfield W.—WNE
Williams, Robert C.—CO
Williams, Robert F., Jr.—RO
Williams, Robert J.—PH
Williams, Stanley M.—SL
Williams, Walter P.—UMW
Wills, Eugene—CHI
Wilson, Charles R.—SS
Wilson, Earl—CHI
Wilson, George A.—ENE
Wilson, G. C.—PH
Wilson, G. J.—MV
Wilson, Harold K.—PNW
Wilson, Harry R.—PH
Wilson, Howard E.—TO
Wilson, Howard L.—CHI
Wilson, Ivan V.—WNE
Wilson, Jesse A., Jr.—RM
Wilson, Joseph H.—NWK
Wilson, Marvin R.—MV
Wilson, O. B.—ONT
Wilson, Oran C.—CA
Wilson, Robert J., Jr.—NWP
Wilson, Robert R.—NWP
Wilson, Wilfred K.—WNE
Winding, Charles C.—RO
Windman, Samuel—SC
Winfield, Armand G.—SL
Wing, C. Burton—RO
Winkelmann, H. A.—CHI
Winiarski, Edmund A.—NWK
Winn, Hugh—CA
Winstead, Thomas W.—BW
Winter, Charles W.—DET
Winter, Quentin—CHI
Winterer, George D.—PV
Wintermute, Glenn E.—CI
Winters, Ralph M., Jr.—PH
Wismer, Earl B.—PH
Wismer, Harvey G., Jr.—PH
Withers, E. P., Jr.—SS
Witkowski, Henry J.—NWP
Witt, Charles L.—TO
Witt, Ralph K.—BW
Wittek, John—NWK
Wittenauer, R. H.—ENE
Wittman, Lawrence—NY
Wiza, Peter P., Jr.—CHI
Wnukowski, Robert J.—GG
Wodetsky, Elmer—NY
Wodzinski, Edward S.—BUF
Woernle, Arthur K.—NWK
Wohlfarth, Edward J.—NWK
Wohlleben, Max G.—NWK
Wohlrabe, James F.—MIL
Wokeck, E. O.—CHI
Wolcott, James H.—CHI
Wold, Trygve—ONT
Wolek, Joseph—SL
Wolf, George M.—NI
Wolf, Van J.—MV
Wolfe, Charlotte—ENE
Wolfe, Laurence H.—KC
Wolfe, Paul D.—PH
Wolford, Edwin Y.—PI
Wolff, Otto J.—NS
Wolfson, Charles—DET
Wolheim, Joseph B.—NY
Wolk, Charles—CA
Wolock, Irvin—BW
Woo, Howard F.—UMW
Wood, Fredric E.—CHI
Wood, James E.—CHI
Wood, James R.—DET
Wood, Phillip W.—CI
Woodard, Robert A.—NY
Woodham, Howard W.—CHI
Woodman, Edwin E.—CHI
Woodmansee, Harold D.—CA
Woodruff, Douglas, Jr.—RO
Woodruff, John H.—RO
Woodruff, William K.—CHI
Woods, Vincent L.—DET
Woodson, Leslie A.—SC
Woodward, Brandt—GG
Woodward, C. A.—ENE
Woodward, LeRoy A.—SS
Woodward, Robert B.—ENE
Woodworth, Parke—SL
Woolley, Glenn S.—ONT
Worden, Joseph L.—NWP
Workman, Robert E.—CA
Worstell, Melvin L.—PI
Woxblom, George G.—NWK
Wray, E. Edward—SEO
Wright, George W.—ENE
Wright, Jack C.—ST
Wright, Jas. A.—NWK
Wright, Kenneth F.—CHI
Wright, Ralph E.—RO
Wright, Robert A.—MV
Wright, Thomas H., Jr.—CHI
Wright, Val—CHI
Wright, Walter E.—SC
Wuest, Louis M.—CO
Wulc, Stanley S.—PH
Wulf, Bernard J.—CA
Wulfert, Otto—SL
Wunsch, M. A.—PH
Wurtzell, Frederick W.—CHI
Wyckoff, John H.—SC
Wylegala, Kenneth B.—NY
Wymore, Alvin C.—CHI

Y

Yahn, Robert B.—WNE
Yahner, Jack C.—CA
Yamamoto, Kimio—OSA
Yanulis, Michael J.—NWK
Yarm, Sidney D.—NY
Yarnall, D. I.—PH
Yasuda, Toshiro—OSA
Yates, Cyril J.—KI
Yates, R. N.—NWP
Yedlick, Elmer J.—NWK
Yelley, Clifford R.—CA
Yelverton, Richard W.—NWK
Yesikenas, Peter—WNE
Yorker, Neal C.—RM
Yorker, Oscar B.—RM
Yoshida, Keinosuke—OSA
Yost, William F., Jr.—SEO
Young, A. C.—SC
Young, Amps P.—MV
Young, Clem J.—KI
Young, Ernest H.—CHI
Young, Fletcher R.—NWP
Young, Foster J.—CA
Young, H. Clifton—PH
Young, J. Arthur—RSM
Young, John D.—DET
Young, John L.—WNE
Young, Paul W.—TO
Young, Sherwood L.—WNE
Young, William G.—NY
Young, William H.—NWK
Young, Wm. H., Jr.—BW
Yurecka, Milton J.—BI

Z

Zabel, Herman W.—NY
Zacks, Edward A.—NWP
Zador, George—ONT
Zaehring, William E.—SC
Zampol, Peter—DET
Zappa, Joseph F.—NWK
Zarebski, Michael A.—ONT
Zavasnik, Fred J.—PNW
Zavist, A. R.—WNE
Zawodni, James T.—DET
Zazzara, Patrick B.—NWK
Zeekaf, J. G. M. E. H.—NS
Zeelo, Jerry—CA
Zeelo, Thomas—CA
Zegota, Walter E.—DET
Zeiner, Emmett J.—SC
Zeisberg, Millard D.—PH
Zellen, Everett B.—RSM
Zelley, Fenimore B.—NWK
Zenner, Justin—CHI
Zerlin, Richard M.—SC
Zevin, Arthur H.—NY
Ziah, James R.—CHI
Ziegfeld, C. J.—NWK
Ziegler, Joseph—CHI
Zietlow, John F., Jr.—BUF
Zimmerman, Abe—NWK
Zimmerman, Alan K.—NY
Zimmerman, Charles C.—SC
Zimmerman, Harry M.—CA
Zimmerman, Robert O.—CO
Zimmerman, Samuel—NY
Zimmerman, Sanford S.—NY
Zimtbaum, Samuel D.—NY
Zink, Norbert G.—RO
Zipkin, Samuel—RSM
Zola, John C.—SC
Zolman, G. R.—TO
Zrada, Walter T.—NWK
Zubrin, David—DET
Zumstein, Fred—DET
Zurawel, Fred A.—RSM
Zurkoff, Bernard—NWK
Zurlinden, Paul R.—CA
Zyskowski, A. E.—NWK

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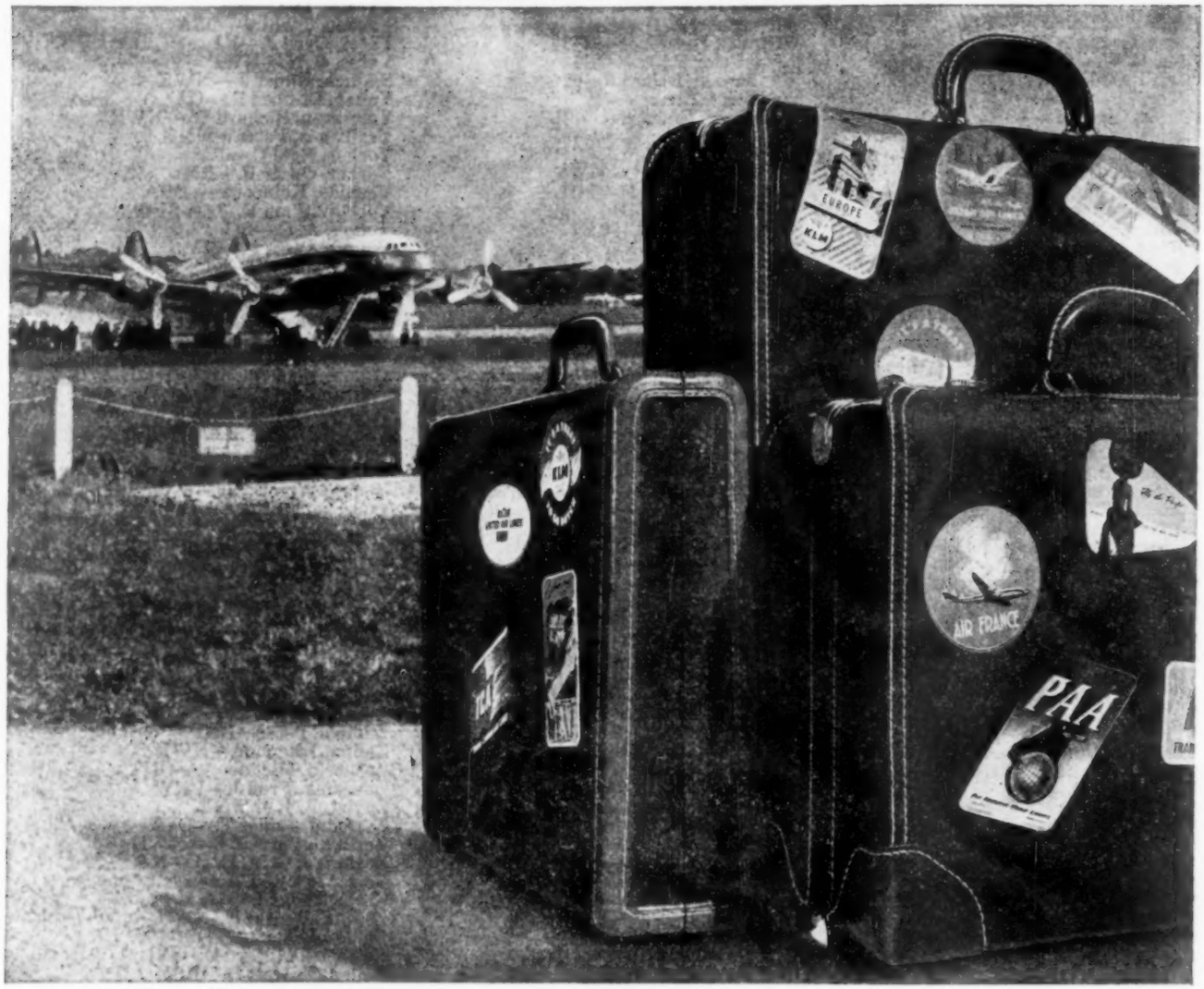

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Danger in the Plant . . .

(Continued from Page 36)

Solvents: The first consideration in the selection of a solvent is compliance with local and state health and fire regulations. These regulations frequently specify solvents which may not be used and they further specify safeguards associated with solvents which are permitted. From a standpoint of health and safety, the primary factors in the selection of a solvent are flammability, skin irritation qualities, toxicity and obnoxious odors. These are in addition to such factors as the rate of evaporation, effectiveness as a detergent and cost.

The following precautions should be employed in the handling of solvents:

1. Proper ventilation.
2. Bulk storage facilities should be located so that in case of fire no other part of the plant is endangered.
3. Drums of solvents should not be stored in working areas; only small amounts of solvents should be taken to molding area.
4. The spilling of solvents should be avoided. Vapors may flow long distances along the floor or ground to be ignited and flash back.
5. Contaminated solvents which are not reclaimed should never be poured down a drain or sewer. They should be transported in a closed container to a safe dump or open area.

Trimming

Trimming of reinforced plastic parts is done in two basic manners: (1) by machine or jig; (2) by hand, cutting or grinding to a line. Cutting machines and jigs, used for long run jobs, can be "made" safe. The cutting edge can be encased in a guard and the piece being trimmed can be held firmly in place with clamping devices. In all cases the machine should be grounded, particularly if the part is being trimmed wet. A faster, cleaner cut is obtained by using water as a lubricant. When cutting wet, rather than water just sprayed on cutting wheel and then allowed to drain onto the floor, some means of retrieving and re-using the water should be devised. Wet floors are a definite slip hazard and should be avoided. When a permanent trim tool is installed, an exhaust system should be tailored to the machine. Means of removing the dust at the source can be devised by using flexible hose of sufficient diameter. If this is not practical, the work area should be enclosed in a booth (and the air exhausted at a minimum speed of 50 feet per minute, based upon cross sectional area of enclosure). The operator should be in the path of the fresh air.

Hand trimming of large parts requires a more skilled operator. He should be equipped with gloves, goggles and respirator. Parts being hand trimmed should be placed in an exhaust booth where the air travels past the operator. All electric tools should be grounded by means of a 3-wire cord. All parts being trimmed should be held firmly by means of fixture designed specifically for that part.

The band saw is very useful in cutting contoured laminates. A small piece of tubing directing a low pressure air stream at the point of cutting removes cutting dust, allowing operator to see cutting line clearly. A good shaded light affixed to the saw is a great aid to the operator.

Table saw or radial cut-off saw, using abrasive wheel, is an excellent means of obtaining straight cuts. Guards provided with machines are adequate and should not be removed.

The work-horse of the industry is the heavy duty grinder, fitted with an abrasive wheel. Two hands are required to operate this tool, so part being trimmed must be firmly held. Before using tool, a careful inspection must be made of the abrasive wheel, looking for cracks that could cause the wheel to disintegrate at high speeds. When changing or replacing abrasive wheels, always use paper discs on either side of the wheel to make up for any discrepancies in alignment. This practice will prevent cracked and broken wheels during usage.

Air disc sanders used frequently in hand operation should be held firmly with two hands in such a manner that rotation of disc throws sanded material away from operator. In the use of cutting tools of this nature, the operator must be compelled to wear safety goggles and be made constantly aware of other employees working in the vicinity. Their safety and comfort as well as his own are his responsibility.

It will be noted that the emphasis of trim tools is on air operated equipment. Air driven tools are preferred for the following reasons:

1. No danger of electric shock.
2. Over-loaded, an air tool will stall rather than bind and injure operator.
3. Require less maintenance. In a dusty operation, electric motors become dirty; overheat, causing insulation breakdown and resultant short-circuiting, grounding and tool failure.
4. Can be used with wet or dry cutting operations with no electrical difficulties.
5. Eliminates power panels, plugs and receptacles.
6. Tools lighter, more compact, shock resistant; reduce worker fatigue.
7. Gives worker infinite variations of speed by trigger or handle adjustment not obtainable with electric equipment.

Air Drills: Drilling causes high degree of heat at cutting edges. Wet drilling where possible is desired to prolong life of cutting instrument. Drills and cutting tools should always be securely tightened in chuck. Proper size chuck key should be affixed to drill or hose to facilitate this operation. Good drilling practices, proper use of lubricant and use of sharp tools should be taught to all workers.

Kett or Rotary Saw: Used when smaller detailed cuts or cut-outs are required. The rotation of this blade is opposite of the direction of tool movement creating possibility of "kick-back". Cut should be started gradually and tool held firmly using two hands.

Oscillating Saw: Also used for cut-outs or hard-to-get-at places. Starting holes should be large enough to accommodate blade. Do not attempt to remove blade from work until all movement has stopped.

Hand Routers: Used in close tolerance work utilizing rotary files. Work must be firmly supported to prevent chatter and permit worker to hold tool with two hands. When using aforementioned hand tools, operator should be compelled to wear safety goggles.

Rivet guns, impact and squeeze: Rivet guns should not be used unless rivet set is retained spring. Assembly personnel require higher degree of training and constant education is necessary on proper usage of rivet guns. Equipment of this nature is usually operated on reduced air pressure. Proper pressure and methods of using tools are all part of training. Accident-free operations go hand in hand with properly instructed personnel.

All parts manufactured go through Trim Section, necessitating handling of products in various stages of completion. Reinforced plastics prior to trimming often

have sharp edges; employees should be instructed to use proper hand coverings when handling parts to prevent cuts. In all trimming operations, dust and chips are prevalent in varying degrees. Goggles should always be available and their use enforced whenever necessary. Eye injuries are high in frequency and can only be decreased by enforcement of use of protective equipment.

One of the supervisor's major responsibilities is the scheduling, routing and storing of parts in process. Parts should be racked in such a manner as to be convenient for workers to handle with the least amount of motion; stacked in such a way as to prevent falling; taken out of the shop on to the next operation as soon as possible.

It is a fact that workers spend more time walking around dirt, trash and accumulated parts than is used in actually cleaning up. Good housekeeping is very essential to safe trim operations. Trimmed flash must be removed immediately and placed in proper receptacles. It is sharp and unwieldy, conducive to all nature of accidents.

Dust: Good housekeeping is important in the control of dust. Dust on ledges and overhead beams in trim areas should be removed by vacuum units or dust collecting equipment. Dust accumulations may become stirred through such movements as the opening or closing of a window or door. This can result in a suspension far more hazardous than when the dust is dormant. If ignited from sources like sparks or flames, dust may set up a chain reaction of explosions which may be far more disastrous than fire.

Finishing:

Sand Blasting: Sand blasting (low pressure) should be confined to isolated, well-exhausted enclosed area. Operator should wear protective clothing, gloves and hood that covers head, face, neck and shoulders. Parts being sand-blasted should be firmly held in position by jig, holding fixture or frame work so that operator's attention may be devoted solely to sand blasting operation.

Nozzles, gaskets, hose and fixtures should be checked daily so that replacement of worn parts can be made before leakage occurs. Operator should be compelled to wear approved type of respirator hood. Operator should stand in path of fresh air coming in and direct blast toward exhaust. Extreme care should be exercised in handling parts, particularly untrimmed parts, to prevent cuts from sharp edges and flash. Leather palm gloves should be worn at all times.

Spray Painting: All spraying of primers, lacquers, enamels and resins should be done in approved type spray booth delivering minimum velocity of 125 feet per minute through opening. Any lighting in area of booth should be non-explosive wiring and vapor globes or explosion-proof fixtures. Spraying materials must be stored in safe area away from any and all fire hazards. Operators must wear approved type respirators and spray in direction of the air flow. Management is responsible for the safe disposal of used thinners and paints.

Sanding operations, hand and machine: Parts being sanded either by hand or oscillating sander should be placed adjacent to exhaust fan or duct to carry dust away immediately. If possible, sanding operations should be wet. This eliminates the dust, gives a better finish and results in longer life of the sanding medium. Care should be exercised in placing of air hoses to sanding machines. Sufficient air outlets in finishing area eliminate long runs of hose strewn all over the floor. One hose supplying a manifold at working area greatly reduces falling caused by hoses all over floor.

Exhaust Fans: An area devoted entirely to sanding operations must be adequately ventilated. This can be accomplished by the use of exhaust fans and exhaust ducts to immediate areas. Requirements will vary with job changes but aside from special applications, one area can be set up for small parts, another for large parts.

Ladders and Scaffolds: Finishing large parts often requires employees to work above floor level. In addition, they are required to carry tools or spraying equipment. Wherever possible, scaffolding should be used. Lightweight metal scaffolding can be obtained in modules permitting adjustment for various jobs. Self-locking trolley ladders are also suggested equipment.

Ladders should be purchased from manufacturers whose products conform to the A.S.A. code for the construction, care and use of ladders. Ladders should be inspected regularly. Those which cannot be safely repaired should be destroyed immediately to avoid the temptation of using them in emergencies.

Ladders not in use should be hung against a wall with more than two supports for long ladders to prevent their warping. They may be placed edgewise on racks or on rollers rather than stored flat.

The footing of portable ladders should be made secure with non-slip bases. These bases should be examined regularly for wear or damage so as to insure their effectiveness.

Worker Training

Supervisors should train workers in the following safe practices with ladders:

1. Extend step ladder fully before using and make sure it is in locked position.
2. Do not use a ladder as a guy, brace or skid, or horizontal member or for purposes other than for which it was originally intended. Short ladders should not be lashed together to gain added length.
3. Do not place ladders in front of unlocked or unguarded doorways.
4. Use the right ladder for each job.
5. Do not slide or jump off a ladder.
6. Wear shoes in good repair, check to see that the soles of your shoes are not greasy or sticky, that you have no loose shoe strings.
7. Keep ladders clean and free from dirt and grease which might conceal defects. Painting ladders hides defects; a coating of linseed oil is recommended.

Air Hoses: Used properly, the compressed air hose is a useful and timesaving device in the plastics industry. Used improperly, it is powerful enough to kill.

Horseplay with an air hose is extremely dangerous. One industrial doctor attributed this cause to more than 80 cases of complete rupture of the bowels and 30 cases of incomplete rupture, with a death rate of 70%. It requires only 4 psi to rupture a bowel. Clothing is no barrier. Hearing has been lost by playful blasts in the ear; eyes have been damaged when plastic bits have been blown into them; faces have been disfigured by blasts of grease and dirt.

To prevent compressed air accidents, the employer should:

1. Provide sound and strong hose with secure couplings.

(Please turn to Page 144)

Plastic Tooling Uses of Polysulfide–Epoxy Resins

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Thiokol Chemical Corp.
Trenton, New Jersey

TOOLING WITH PLASTICS is steadily gaining momentum in diverse industries. Lower tooling costs and weight factor, reduction in tooling time which results in greater production lead time, versatility in the use of materials and manpower, and greater freedom in design are some reasons for the rapid growth of plastic over metal tooling. The use of cast plastic structures in tooling is increasing because lower materials and labor costs are involved than with the fabrication of tools by laminating with reinforcement layers. This requires a suitable casting material possessing a unique combination of properties (1).

Due to their ease of handling, long shelf life, good adhesion properties, low shrinkage, strength and versatility of cure, the liquid epoxy resins are considered the most versatile resins used in plastic tooling applications (2, 3). However, for cast plastic tooling structures they are too brittle and require a flexibilizer. Thiol-terminated liquid polysulfide polymers are saturated aliphatic elastomers and co-react with epoxy resins. To obtain useful materials, hardeners are required and cures are obtainable at room or elevated temperatures. The polysulfide polymers function as chemically combined flexibilizers (4, 5, 6, 7). They impart toughness, resistance to repeated impact and temperature cycling, resilience and reduced moisture vapor transmission in epoxy resin tooling compositions. Plastic tooling is the largest volume and one of the most active commercial uses for these compositions at the present time.

Reaction Temperature Rise

Much information and data have been published on the effect of polysulfide liquid polymers on some mechanical, electrical and chemical resistance, and heat distortion properties of epoxy resins (4, 5, 6). However, some properties which are of vital importance to the plastic tooling compounder, engineer and fabricator were only superficially investigated. A primary objective of this study was to investigate the effect of polysulfide polymer and fillers on the exothermic reaction temperature rise, coefficient of linear thermal expansion, shrinkage on conversion, impact resistance, and compression properties of epoxy resin casting compositions. Another objective was to determine the effect of room temperature aging on the hardness, impact resistance, and resilience of some formulations.

Polysulfide liquid polymer-modified epoxy resin compositions can be formulated to meet specific requirements for plastic tooling applications. Fillers are readily dispersed in either or both polymers by paint milling. Some fillers can be satisfactorily incorporated in the polymers by hand mixing. However, optimum dispersion is obtained by paint milling.

Hardening Agents

When hardening agents that are compatible with the polysulfide polymers are used, the compositions can be prepared as a two-package mix with good shelf stability. Some compatible hardeners are benzyl dimethylamine (Rohm and Haas Company), tri-(dimethyl aminomethyl) phenol (DMP-30), dimethyl aminomethyl phenol (DMP-10-Rohm and Haas Company), meta phenylene diamine (National Aniline Company), and Epon Curing Agent Z (Shell Chemical Company). However, if non-compatible hardeners are employed, a three-package mix is advisable when long shelf life is required. Amine hardeners such as triethylenetetramine and diethylenetriamine (Carbide and Carbon Chemical Company) are in this class and are separately packaged. Styrene oxide (Dow Chemical Company), allyl glycidyl ether (Shell Chemical Company), and acrylonitrile (American Cyanamid Company) have been found to be interesting coupling agents for compatibilizing these amines in polysulfide liquid polymer LP-3. Acrylonitrile is the most effective for this purpose.

There are several liquid polysulfide polymers commercially available for flexibilizing epoxy resins. Some pertinent properties of these polymers are listed in Table I (8). Although the higher molecular weight polymers, LP-2 and LP-32, have been used for modifying epoxy resins, their use is limited in casting applications because of their relatively high viscosity. The lower viscosity polymers LP-3, LP-33 and LP-8 are primarily used in plastic tooling applications. In this study, LP-3 was employed as the flexibilizer because it is used the most extensively in the field and is very adaptable in plastic tooling applications.

Liquid ethoxylene resins suitable for plastic tooling

This paper was presented at the Thirteenth SPE Technical Conference.

Table I Properties of Commercial Liquid Polysulfide Polymers

Polymer	Composition, Mole % Bis (2-Chloroethyl) Formal	Composition, Mole % Trichloropropane	Specific Gravity 20°/4°C	Viscosity at 25°C Poises	No. Avg. Mol. Wt.	Pour Point °F
LP-2	98	2	1.27	350-450	4,000	35
LP-32	99.5	0.5	1.27	350-450	4,000	45
LP-3	98	2	1.27	7-12	1,000	−15
LP-33	99.5	0.5	1.27	13-15.5	1,000	5 to 10
LP-8	98	2	1.27	2.5- 3.5	500-700	−25

Table II Filler Properties

Filler	Specific Gravity	Apparent Density, lbs./cu. ft.	Mesh Size	Particle Size Range, Microns	Coefficient of Linear Thermal Expansion/°C
Milled Glass Fibers[a]	2.6	—	0.031-in.	—	—
Stupalith A-2410[b]	2.6	37.5	98% thru 200	—	-6x10-6
(Lithium Aluminum Silicate)				—	—
Graphite 1230[c]	2.5	25	95% thru 300		
Lo-Micron Quartz 868[d]	2.63	67.4	100% thru 130	—	0.05x10-6
Atomite 319[d]	2.71	24	99.9% thru 325		
(Water Ground Calcite, Calcium Carbonate)				0.5 to 10	0.5x10-6

a. Fiber Glass Division, Ferro Corporation, Nashville, Tenn.
b. Stupakoff Division of the Carborundum Co., Latrobe, Penna.
c. George F. Pettinos, Inc., Philadelphia, Penna.
d. Whittaker, Clark and Daniels, Inc., New York, N. Y.

Table III Liquid Polysulfide Polymer-Epoxy Resin Formulations

	Epoxy Resin, 100 Pts. by Wt. TET,[a] 10 Pts. by Wt. Cured @78 ± 4°F & 45 ± 5% R.H.				Epon Curing Agent Z, 20 Pts. by Wt., Cured 24 Hrs. @150°F			
LP-3, Pts. by Wt.	0	25	50	100	0	25	50	100
Filler								
None	—	—	—	—	—	—	—	—
Milled Glass Fibers								
Pts. by Wt.	28	34	39	51	59	71	82	104
% by Volume[b]	10	10	10	10	18	18	18	18
Stupalith A-2410								
Pts. by Wt.	75	90	106	136	95	113	131	167
% by Volume[b]	23	23	23	23	26	26	26	26
Graphite 1230								
Pts. by Wt.	22	27	32	41	32	38	44	56
% by Volume[b]	8.5	8.5	8.5	8.5	11	11	11	11
Lo-Micron Quartz 868								
Pts. by Wt.	80	96	113	146	123	146	170	216
% by Volume[b]	24	24	24	24	31	31	31	31
Atomite 319								
Pts. by Wt.	82	99	116	150	94	112	130	165
% by Volume[b]	24	24	24	24	25	25	25	25

a. Triethylenetetramine
b. Percent by volume of filler based on total volume of compound

Table IV Percentage Volume Shrinkage During Conversion

Filler	TET Cure[a] LP-3, phr[c] 25	50	100	Epon Curing Agent Z Cure[b] LP-3, phr 25	50	100
None	4.8	3.9	3.6	3.9	4.5	2.7
Milled Glass Fibers	3.5	3.4	3.2	2.3	2.5	1.5
Stupalith A-2410	2.8	2.8	2.4	1.2	2.1	0.6
Graphite 1230	3.6	3.1	2.8	1.5	1.5	1.2
Quartz 868	2.9	2.0	1.6	1.5	0.6	0.1
Atomite 319	2.3	2.4	2.4	1.9	2.4	1.8

a. Triethylenetetramine. 2 Days at 78 ± 4°F and 45 ± 5% R.H.
b. 24 Hours at 150°F plus 2 days at 78 ± 4°F and 45 ± 5% R.H.
c. Parts by wt. per 100 parts epoxy resin

and casting applications are produced by several manufacturers. The liquid epoxy used in this study has a viscosity range of 4,000 to 10,000 centipoises at 25°C, 0.48 to 0.57 gram equivalent of epoxide per 100 grams resin and a specific gravity of 1.16. Incorporation of the low molecular weight polysulfide polymers in epoxy resins usually results in casting compositions of lower viscosity than are obtained with the unmodified epoxy resin (6). Thus, higher filler loadings are possible with the modified epoxy compositions.

Some properties of the five fillers used in this study are recorded in Table II (9). Stupalith A-2410 is an interesting filler in that it has a negative coefficient of thermal expansion. The polysulfide liquid polymer-epoxy resin formulations investigated are shown in Table III. These compositions were prepared as two-package mixes. One part consisted of LP-3, hardener and a portion of the filler and the other part contained the epoxy resin and the remainder of the filler. The 1:1 ratio, LP-3/epoxy resin formulations were loaded with the fillers to a Brookfield viscosity of 30,000 centipoises at 80°F. This viscosity was considered to be the maximum for good handling. The same volume percent filler, based on total compound volume, was used in the other LP-3/epoxy resin ratios. It is evident that the volume loading of filler varies with its type and particle characteristics. All fillers were paint milled into the polymers.

Triethylenetetramine (TET) was selected as a typical hardener for the room temperature cures and Epon Curing Agent Z for the elevated temperature cures. A heat cure of 24 hours at 150°F was selected because it is considered practical for most industries engaged in plastic tooling.

Although the viscosity of Epon Curing Agent Z is higher than that of TET and a larger amount was used, higher filler loadings were possible in the formulations containing this hardener. We have found that for a given viscosity higher filler loadings are obtainable in two-package mix, LP-3-flexibilized epoxy compositions when the hardener used is compatible with the LP-3.

Exothermic Temperature During Cure

Maximum temperature rise due to reaction exotherm is an important factor to be considered with epoxy and polysulfide polymer-modified epoxy casting compositions in plastic tooling applications. If the temperature rise is excessive, the castings will char. High cure temperatures due to reaction exotherm increase the apparent shrinkage of these compositions because of their high coefficients of thermal expansion. Usually, temperature rise is not a problem in small castings. However, it becomes a problem with large castings, such as drop hammer dies, when active room temperature curing hardeners are used and the surface area to volume ratio is low.

Modification of the epoxy resin with LP-3 reduces the maximum reaction temperature rise in unfilled and filled compositions cured at room temperature with TET and at 150°F with Epon Curing Agent Z. Fillers such as Stupalith A-2410 and Atomite 319 decrease the reaction temperature of the unmodified and LP-3-modified epoxy compositions. Lower reaction temperatures were obtained with Epon Curing Agent Z, which requires a heat cure, than with the room temperature cures with TET. Typical maximum reaction temperature curves are illustrated in Figure 1. These data were obtained with 200 cc of material in insulated cardboard containers. The castings were 1 inch thick and 4.25 inches in diameter. Room temperature was 78 ± 4°F and the relative humidity, 45 ± 5%.

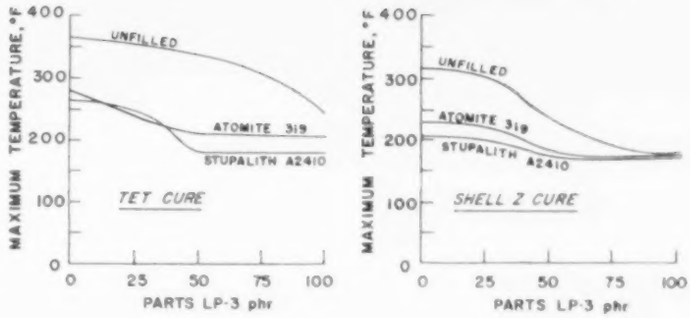

Figure 1. (above) Effect of LP-3 and fillers on maximum exotherm temperature.

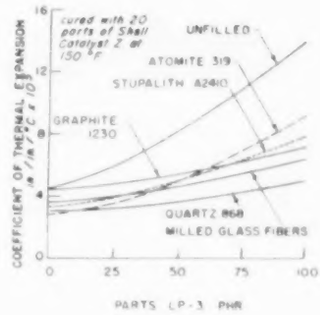

Figure 2. (right) Coefficients of linear thermal expansion of LP-3/epoxy resins.

Coefficient of Linear Thermal Expansion

The coefficient of linear thermal expansion of the material used in plastic tooling is an important property which must be taken into consideration in many applications (10). Large plastic, press tools, such as drop hammer dies, are often stored and used under conditions where the temperature varies over a wide range. In many cases the plastic materials used in the fabrication of drop hammer dies are utilized as a capping over a supporting core such as Kirksite and steel. The coefficients of expansion of epoxy resin and polysulfide polymer-modified epoxy resin compositions are considerably higher than those of metals. Consequently a severe stress is imposed on these materials during thermal cycling. A similar problem is encountered when metal parts are embedded in these materials or when the compositions are cast in metal containers. Although polysulfide polymer-modified epoxy resins have higher coefficients of linear thermal expansion than do epoxy resins, they possess better resistance to temperature cycling. Due to their inherent flexibility, they are able to absorb more stress and strain which result from differences in coefficients of thermal expansion.

The average coefficients of linear thermal expansion of unfilled and filled epoxy and LP-3-modified epoxy resin compositions were determined on 0.5 x 0.5 x 5-inch cast bars over the temperature range of −40 to +40°C. Air was used as the test medium and optical measurements were made to the closest 0.0005-inch. These compounds were cured 24 hours at 150°F with Epon Curing Agent Z and tested after conditioning for 30 days at 78 ± 4°F and 45 ± 5% relative humidity. Hereafter, this will be referred to as standard conditioning.

Figure 2 shows the coefficient of linear thermal expansion increases with increase in LP-3 concentration. Fillers reduce the coefficients of expansion. This is to be expected since they have considerably lower coefficients of thermal expansion than epoxy resins and liquid polysulfide polymers. It is interesting to note the lowest overall co-

Table VI Compressive Properties at Room Temperature TETa Cure

Filler	Maximum Compressive Strength, PSI	Yield Strength (0.2% Offset) PSI	Modulus PSI	Deformation[b] at Yield, %
None				
LP-3, phr				
0	16,300	15,900	5.12×10^5	3.4
25	8,300	7,400	2.3×10^5	3.5
50	3,400	2,800	8.1×10^4	4.0
Milled Glass Fibers				
LP-3, phr				
0	19,500	16,200	7.7×10^5	2.0
25	11,300	8,900	4.7×10^5	2.2
50	5,400	3,600	1.6×10^5	3.0
Stupalith A-2410				
LP-3, phr				
0	16,000	12,800	7.8×10^5	1.9
25	11,000	9,500	4.1×10^5	2.7
50	6,000	4,800	2.2×10^5	2.4
Graphite 1230				
LP-3, phr				
0	15,100	12,700	6.3×10^5	2.5
25	8,500	6,300	3.0×10^5	2.2
50	3,700	2,100	9.6×10^4	2.4
Quartz 868				
LP-3, phr				
0	15,600	13,300	6.2×10^5	2.6
25	11,900	9,800	5.3×10^5	2.0
50	5,200	3,600	2.3×10^5	2.0
Atomite 319				
LP-3, phr				
0	16,000	13,200	6.5×10^5	2.1
25	10,600	9,800	4.4×10^5	2.7
50	5,700	3,400	2.1×10^5	1.8

a. Triethylenetetramine *b. 0.2% Offset*

Table VI Compressive Properties at Room Temperature Epon Curing Agent Z Cure

Filler	Maximum Compressive Strength, PSI	Yield Strength (0.2% Offset) PSI	Modulus PSI	Deformation[a] at Yield, %
None				
LP-3, phr				
0	17,100	15,800	4.5×10^5	4.2
25	12,900	11,600	3.6×10^5	4.3
50	5,100	4,300	1.1×10^5	4.1
Milled Glass Fibers				
LP-3, phr				
0	20,100	17,300	1.1×10^6	2.9
25	16,200	13,600	6.7×10^5	2.3
50	10,000	8,000	4.5×10^5	2.0
Stupalith A-2410				
LP-3, phr				
0	18,600	14,800	9.1×10^5	2.0
25	16,400	12,400	7.0×10^5	1.8
50	5,500	4,000	1.8×10^5	2.5
Graphite 1230				
LP-3, phr				
0	16,200	11,000	6.3×10^5	2.0
25	13,900	9,900	5.3×10^5	2.2
50	6,000	4,500	2.2×10^5	2.5
Quartz 868				
LP-3, phr				
0	20,400	15,400	9.8×10^5	1.9
25	16,200	12,400	6.8×10^5	1.8
50	6,600	4,100	2.9×10^5	1.6
Atomite 319				
LP-3, phr				
0	17,200	14,300	6.8×10^5	2.5
25	13,700	11,400	5.2×10^5	2.5
50	7,400	5,600	3.3×10^5	2.0

a. 0.2% Offset

ficients of expansion were obtained with the compositions ntaining Quartz 868. The volume loading was highest th this filler. In view of the relatively low volume loading sed, milled glass fibers are very effective for decreasing he coefficient of expansion of liquid polysulfide polymer poxy compounds.

Shrinkage During Cure

In plastic tooling applications where close tolerances of the order of 0.002 to 0.003-inch are required, the shrinkage of the material during conversion from the liquid to the solid state is of great importance. Percentages volume shrinkage of the LP-3-modified epoxy resin systems were determined and are recorded in Table IV. The volume shrinkages of these materials are low; ranging from 2.7 to 4.8 percent with the unfilled formulations. Fillers reduce volume shrinkage; values ranging from 0.1 to 3.5 percent were obtained. Quartz 868 is very effective for reducing volume shrinkage. The compositions cured with Epon Curing Agent Z gave lower volume shrinkage on conversion than those cured with TET. This is what one would expect since lower conversion temperatures are associated with this cure. Volume shrinkage did not significantly increase after one month aging at the standard conditions. Therefore, practically all of the shrinkage occurs during conversion from the liquid to the solid state.

A brief description of the method used for determining volume shrinkage is considered to be of interest. The compositions were cast in 7/8-inch diameter pyrex test tubes 7 inches in length, previously coated with release agent, whose volumes were accurately determined. After the prescribed cures, the specimens were removed by cooling with dry ice. When they attained standard temperature, they were placed in 100 cc graduates previously calibrated in the same manner as the test tubes. The volume of Ponsolve required to fill the graduates to the 100 cc mark was then carefully measured with a buret. Percentage volume shrinkage was calculated as follows:

$$S = V_1 - (V_2 - V_3) \times 100 / V_1$$

S = Percent volume shrinkage
V_1 = Volume of original casting
V_2 = Volume of graduate
V_3 = Volume of Ponsolve required to fill graduate containing casting

Impact Resistance

High impact resistance is obviously essential in drop hammer dies. Epoxy resins are brittle and require a flexibilizer to make them suitable for this plastic tooling application. Good resistance to impact is also necessary in most cast plastic tools for protection against cracking and shattering during handling. The effect of LP-3 and different types of fillers on the impact resistance of the epoxy resin is graphically illustrated in Figure 3. It is apparent that the impact strength of the epoxy resin is markedly improved by co-reaction with LP-3. Many of the specimens containing 100 parts of LP-3 did not fail at 107 foot-pounds which is the limit of our test equipment. Milled glass fibers are outstanding for improving the impact resistance of the unmodified and LP-3-modified epoxy resin compositions.

Impact resistance tests were conducted on 0.5 x 2 x 2-inch cast specimens at 80°F with the falling ball method described in Government Specification Mil-C-16923A. The specimens were tested after the standard conditioning.

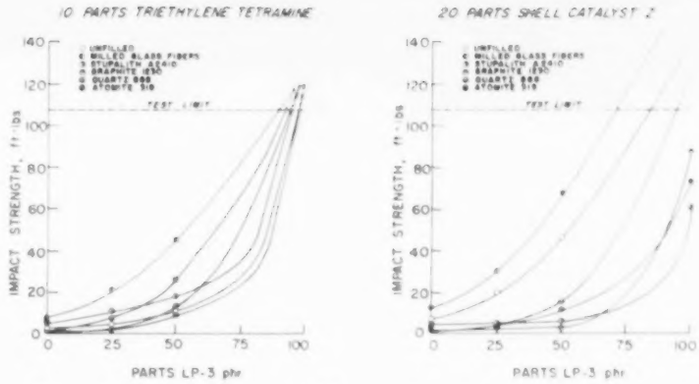

Figure 3. Effect of LP-3 and fillers on impact strength of epoxy resin.

Heat Distortion

The heat distortion temperature (HDT) of materials used in plastic tooling is a property which is of interest to the tooling engineer. Considerable information covering the heat distortion properties of epoxy and polysulfide polymer-flexibilized epoxy resin systems has previously been published (11). But the effect of fillers on the HDT of these compositions was not previously investigated. It was shown that the HDT of the flexibilized epoxy compositions depends on the type of hardener used, the amount of hardener, cure temperature and time, aging time, and the flexibilizer/epoxy resin ratio. Systems which favor high flexibility do not possess optimum HDT. The optimum balance of mechanical properties and HDT must be determined for the particular tooling application.

Heat distortion temperatures of the epoxy and LP-3-modified epoxy resin compositions with and without different types of fillers are recorded in Table V. Polysulfide polymer lowers the HDT of the unfilled and filled epoxy resin compositions. The decrease in HDT is small with the room temperature TET cure. Considerably higher HDTs were obtained with Epon Curing Agent Z and the heat cure. Fillers significantly increased the HDT of the epoxy resin and LP-3-modified epoxy resin formulations with the mild heat cure. However, they were not as effective with the TET cure. TET is not a suitable hardener for obtaining good HDT with either epoxy or polysulfide polymer-flexibilized epoxy materials. Atomite 319 and Stupalith A-2410 were particularly effective fillers for increasing the HDT. It is felt that the reason fillers increase HDT is that they increase the modulus of the compositions.

Table V
Heat Distortion Temperature

Filler	HDT, °C: TET[a] Cure, LP-3, phr 0	TET[a] Cure, LP-3, phr 25	Epon Curing Agent Z Cure, LP-3, phr 0	Epon Curing Agent Z Cure, LP-3, phr 25
None	54	49	80	65
Milled Glass Fibers	56	50	84	75
Stupalith A-2410	56	51	90	78
Graphite 1230	59	56	82	70
Quartz 868	54	47	84	74
Atomite 319	58	56	88	80

a. Triethylenetetramine.

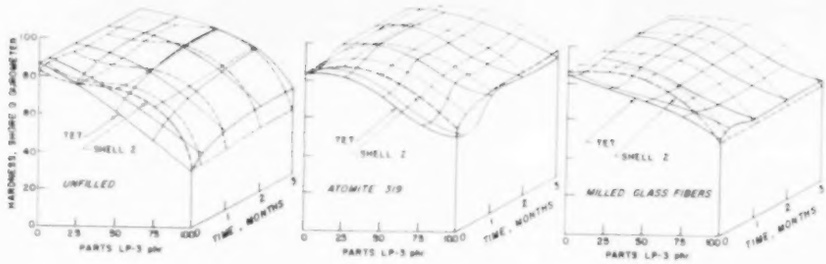

Figure 4.
Effect of aging on hardness of LP-3/epoxy resins.

The HDT was determined in accordance with ASTM, Method D648-45T, Standards pt. VI p. 1176 (1952) (11). All specimens were tested after the standard conditioning.

Compressive Properties

In view of the importance of the behavior of materials under compression in plastic tooling applications, particularly press dies, the effects of polysulfide liquid polymer and fillers on the compressive properties of the epoxy resin were determined. The data recorded in Table VI were obtained in 1.5-inch cast cylindrical specimens 0.5-inch in diameter in accordance with ASTM, Method D695-52T after the standard conditioning. Most of the 1:1 ratio LP-3/epoxy compositions were too soft for measuring their compressive properties on the specimen size used.

Milled glass fibers increased the maximum compressive and yield strengths of the epoxy and polysulfide polymer-modified epoxy resin compounds cured with both hardeners. The other fillers decreased the compressive and yield strengths of the unmodified epoxy resin cured with TET at room temperature. All of the fillers increased the maximum compressive and, in general, the yield strengths of the LP-3-modified epoxy compositions cured with both hardeners. This indicates they are more amenable to reinforcement with different types of fillers. The fillers increased the modulus of all the compositions. Generally, higher compressive and yield strengths were obtained with the mild heat cure. Of the fillers evaluated, Graphite No. 1230 gave the lowest maximum compressive and yield strengths and modulus.

Effect of Aging On Some Mechanical Properties

With the increasing use of epoxy resin flexibilizers in the plastic tooling fields, the subject of cure stability has received considerable attention. The ideal material would possess the required combination of initial properties, such as hardness, impact resistance, resiliency and dimensional stability, for the application and maintain these properties with aging. For drop hammer dies and other cast press tools such a combination of initial properties, coupled with aging resistance, is not feasible with epoxy resins. With polysulfide polymer-flexibilized epoxy resin compositions, maintenance of properties with aging depends to a great extent on the hardener and cure conditions used. Obviously, the more complete the initial cure the better the aging stability. Curing agents, such as diethylenetriamine or dimethylaminopropyl amine (Carbide and Carbon Chemicals Company), which are very active at room temperature, or slower acting curing agents with an elevated temperature cure have more stable properties on aging.

The effects of aging at 78 ± 4°F and 45 ± 5% relative humidity are illustrated in the three-dimensional graphs of Figure 4. Here, the variation of hardness with time for different ratios of polysulfide polymer and epoxy resin is shown. The curing agent is the parameter with Epon Curing Agent Z indicated by the dotted curves while TET is shown by the solid curves. In addition to the unfilled resin, the effects of two fillers, Atomite 319 and milled glass fibers, are also shown. Shore D Durometer hardness measurements were made with the apparatus shown in Figure 5 (12).

It appears that the hardness changes more rapidly in the first month and then levels off, changing only slightly thereafter. The fillers tend to give more uniform and higher hardnesses over the entire range of liquid polymer/epoxy resin ratios. Impact resistance data obtained after various aging periods at the standard conditions are shown in Table VII. With the unfilled formulations, the impact strength of the LP-3-modified epoxy formulations decreased after one month aging, but thereafter did not change appreciably during the 3 month aging period. This

Table VII

Effect of Aging on Impact Resistance

	TET[b] Cure Aging Period				Epon Curing Agent Z Cure Aging Period			
	Impact Resistance Ft.-lbs. [a]							
Filler	**2 Days**	**1 Month**	**2 Months**	**3 Months**	**2 Days**	**1 Month**	**2 Months**	**3 Months**
None								
LP-3, phr								
0	2	3	4	3	10	7	8	9
25	10	5	4	4	24	20	22	23
50	>107	12	21	22	96	46	41	39
100	>107	>107	>107	>107	>107	>107	>107	>107
Atomite 319								
LP-3, phr								
0	2	3	3	3	2	2	3	3
25	3	4	4	5	5	5	5	5
50	19	14	14	15	11	12	12	13
100	>107	>107	>107	>107	64	73	76	78

a. Falling ball test at 80°F. Government Specification Mil-C-16923A.
b. Triethylenetetramine.

parallels the hardness changes. Since the impact resistance of the 1:1 ratio LP-3/epoxy compositions was over the limit of our test equipment, the data obtained on these systems are indefinite. No appreciable change in the impact resistance of the formulations containing the fairly high loading of Atomite 319 occurred during three months' aging. This indicates that fillers are conducive to good aging resistance characteristics in liquid polysulfide polymer-modified epoxy resin compositions. However, much lower impact strengths were obtained with the filler formulations.

The effect of aging on resiliency is an important factor to be considered in plastic tooling applications where the part is subjected to mechanical shock. It is of particular significance in materials used for the fabrication of drop hammer dies. The maximum rebound of the unfilled and filled epoxy and LP-3-modified epoxy resin compositions was determined on 0.5 x 2 x 2-inch cast specimens at 80° F after various aging periods with the Bashore Rebound Resiliometer. A guided, 31.6 gram-weight is released 17 inches above the specimen and the rebound read on a scale calibrated 2.5 units per centimeter (6).

The data in Table VIII show that, in general, the LP-3-modified epoxy compositions maintain their resiliency during aging as well as the epoxy resin materials. The materials showed little change in resiliency during aging. It has been found that the rebound of similar materials increases with increase in hardness. Therefore, if cure progressed appreciably with aging, rebound would be expected to increase. Atomite 319 filler reduces the rebound of the compositions. Of particular interest are the low rebound values obtained with the 1:1 ratio LP-3/epoxy ratio formulations which indicates their ability to absorb more mechanical shock. Most LP-3-flexibilized epoxy drop hammer die formulations contain between 75 and 100 parts LP-3 per 100 parts epoxy.

Summary

Polysulfide liquid polymer-flexibilized epoxy resin compositions possess a unique combination of properties which are required for cast structures in plastic tooling. The properties of these materials can be readily varied from hard and tough to flexible elastomers by adjustment of the polysulfide polymer/epoxy resin ratio, selection of hardener and cure conditions, and use of fillers to meet specific plastic tooling applications. Their ease of handling and compounding with different types of fillers, versatility of cure, high impact strength, resistance to thermal cycling, good mechanical shock dampening, adequate stability of properties during aging, and moderate exothermic reaction temperature rise are some properties which have promoted the acceptance of these materials in plastic tooling applications.

Acknowledgment

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(12) Test apparatus for Shore Durometer measurements manufactured by W. J. Hacker and Co., Inc., 82 Beaver Street, New York City. ★★

Table VIII
Effect of Aging on Bashore Resiliometer Rebound

Filler	TET[a] Cure Aging Period				Epon Curing Agent Z Cure Aging Period			
	2 Days	1 Month	2 Months	3 Months	2 Days	1 Month	2 Months	3 Months
None								
LP-3, phr								
0	50	41	42	41	43	42	44	44
25	47	46	44	44	40	43	44	44
50	41	44	46	46	42	40	42	42
100	21	22	24	23	20	18	20	20
Atomite 319								
LP-3, phr								
0	21	21	23	23	31	30	32	31
25	30	22	22	23	36	36	38	38
50	26	26	26	27	27	30	31	32
100	14	18	19	19	20	24	25	25

a. Triethylenetetramine

SPEAKING OF EXTRUSION

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Heating Systems for Extrusion Cylinders

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Frank W. Egan & Co.

IN THE SELECTION of extrusion equipment an important consideration is the design of the extruder from a thermal standpoint. This includes both the heating and cooling characteristics of the extrusion barrel. The function of the extrusion barrel, that portion of the extruder surrounding the extrusion screw from the feed section to the die, is to supply heat to or to remove heat from the plastic material as it is advanced by the screw. A simple heat balance for an extruder, neglecting the effect of the hopper dryer, friction in the drive section, and radiation losses, is the total heat content of the plastic discharged for a unit of time being equal to the frictional heat added by the action of the screw plus the heat picked up from the extrusion cylinder by conduction.

In the case of adiabatic or autogenous extrusion (see this discussion in the January 1957 column) the amount of heat supplied by the cylinder after start up is theoretically zero. Aside from a few specific applications, where the same compound is used and a constant extrusion rate is maintained to achieve a set melt temperature to produce a certain product, is this method of operating extruders practical? Nearly all the extruders in operation are general purpose machines used to extrude all of the available types of compounds for a range of products, even if restricted to a certain field. The need for accurately controlling the temperature of an extrusion cylinder can be seen from the following explanation.

Need for Temperature Control

Figure I shows the plasticity curves of ten commercially available compounds used for extrusion. They indicate the comparable melt viscosities of these plastics over their range of extrusion temperatures (based on the actual melt temperatures). From experience with one compound it can be determined what proportion of the total heat requirements can be derived from frictional working, when cooling may be necessary, or when heat added by the cylinder is needed to reach the desired melt temperature. With a plasticity range under 1-½, the materials are of too high a viscosity to be extruded. In a range from 1-½ to 5, a considerable amount of frictional heat is involved when extruding at high rates. The requirements of the cylinder heating system, under such conditions, varies from adding the initial heat to get started, to removing the excess heat (frictional) in order to keep the plastic temperature below its decomposition temperature. The extrusion temperature for rigid vinyls and fluorothenes is in the lower part of the range. Highly plasticized vinyls, hard flow cellulosics, high-impact polystyrene and even polyethylene are in the upper part.

From a range of 5 upward the heat requirements are obtained essentially from the cylinder because the plastic has a too low melt viscosity to create sufficient frictional heat to bring it to its required melt temperature. For nylon or polyethylene (film and paper coating) the cylinder supplies the bulk of the heating load. It should be remembered that the capital cost of a one kilowatt heater is about 5 dollars, and to add the equivalent heat with the motor costs about 100 dollars per kilowatt or 20 times the capital investment. The electrical power consumption is equal in both cases although there may be some difference in efficiency.

Control Methods

The cylinder has to supply the heat to the material in the proper proportions as it advances in the machine. If it gets too hot immediately at the feed section, the material will slip on the cylinder walls and rotate with the screw, losing extrusion rates, pressure, and efficiency. For this reason the heating along the cylinder is broken up into two or more zones. With these objects in mind, let us look at the various methods used for controlling the temperature of the extrusion cylinder.

The first extrusion cylinders were heated by steam. The cylinders were cast with cored out section in which the steam was introduced under pressure. Steam is a good heating medium giving fast heat-up. In large installations it is economical, and available control or handling equipment is simple and inexpensive. But in most plants steam is not generally available. Another drawback is the maximum temperature limitation of about 200 psi (or 380°F), which can be safely generated in the average plant. With new thermoplastics requiring higher temperatures new methods of heating were required. Steam heating

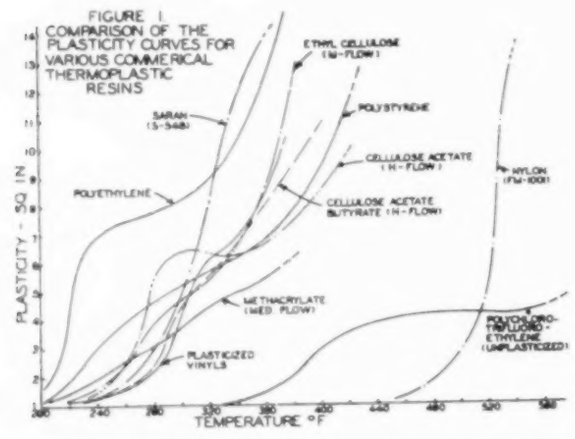

Figure 1. Plasticity Curves

is used chiefly for saran when quick heat-ups are essential.

The next development in the heating of extrusion cylinders was the circulation of hot fluids through the cored sections using oil or Dowtherm. This technique gives an even heat, and when used in conjunction with a heat exchanger, cooling is available. Oil, for the most part, is limited to 550 F because of sludging or carbonization on the heaters. With this type of equipment, maintenance is usually high because of the difficulty of keeping seals tight on pump shafts, and at joints. The space requirements are high and good housekeeping is difficult due to oil leakage. This method is especially desirable in large plants where explosion-proof conditions are required.

Electrical Heating

Direct electrical heating became widely used during World War II because of nylon. This system consists of placing electrical resistance type heaters directly around the outside diameter of the cylinder with controlled zones. Electrical heating is economical and there are no practical upper temperature limitations. This system is not, however, satisfactory on all applications unless provisions are made to remove heat. Direct electrical heating is being used primarily for nylon and polyethylene paper coating work where frictional heat development is not significant.

In conjunction with direct electric heating a number of methods for removing frictional heat for improved temperature control have been developed. Most of these consist of cored cylinders, tubes, and passages through which air, water, steam or fog are circulated. Most of today's machines will fall into one of these categories.

One method (1) is evenly spaced, small cored out areas in the cylinder wall between the liner and the heaters. The flow of the cooling medium is controlled by individual valves on the various channels or zones.

Another method (2) consists of winding a copper tube in a helical groove. The cooling coils are flattened so the heater fits snugly over them. Air, water, or steam can be circulated through them depending upon heat removal requirements.

With the development of cast-in aluminum heaters cooling coils were incorporated in a single casting. A variation (3) of this method, making use of the cast aluminum heater, was the machining of grooves on the inside diameter of the heater to permit the circulation of air.

Further variation of this design was the casting of fins on the outside of the diameter of the heaters in order to increase the surface area. This system can be used with or without a blower. Another system (4) involves the sucking of moisture-laden air over the barrel and heaters in order to improve the cooling efficiency.

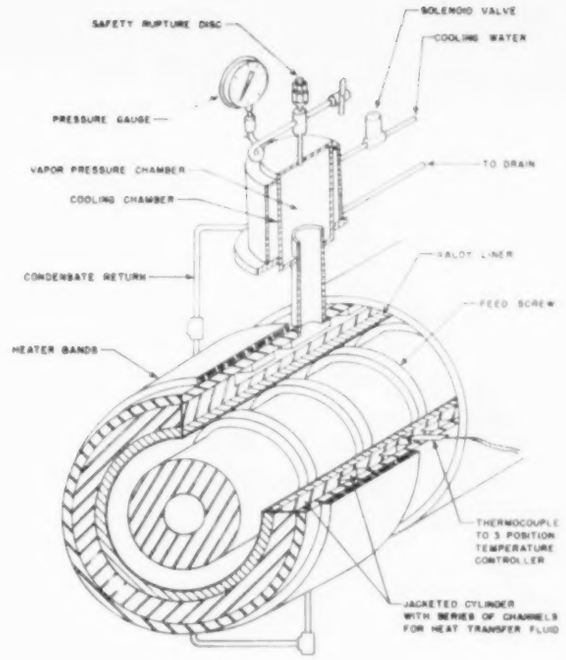

Figure 2. Extrusion heater temperature control system.

The Willert System

The Willert temperature control system on the cylinder used by our company is shown diagrammatically in Figure 2. In this system each zone along the cylinder consists of a series of internal helical grooves connected with channels on the top and bottom. To these passages is fitted a reflux condenser assembly. All joints except the vent, side filling opening, and drain are welded tight for leak proofness. A liquid with a relatively flat vapor pressure vs. temperature range curve is used to fill the jacket. Water for operating temperature up to 435 F and Dowtherm A for 380 to 750 F are recommended. Upon the initial heat up, the system is vented to remove air and noncondensable gases and sealed.

In operation, a vapor pressure corresponding to the cylinder or liquid temperature is maintained. The heat from the electrical heating elements passes around (partially through) the liquid through the metal wall of the cylinder to the liner and transfers to the plastic. Where cooling is required, water is introduced in the condenser jacket, condensing some of the vapors and returning the condensate to the cylinder setting up a circulating system. Since only the latent heat of vaporization is removed, the vapor and condensate are essentially at the same temperature and consequently the control is gradual, producing no shock to the cylinder but effective in removing unlimited amount of frictional heat if necessary.

The control is from a standard thermocouple embedded in the cylinder wall near the liner in the center of each zone. A three position temperature controller is used to close the contractors for turning on the heaters for the heating cycle and to actuate a solenoid valve in the water line to the condenser jacket when cooling is required. The system is completely enclosed, self-contained without moving parts and automatic. A bypass valve is used around a solenoid valve which is opened to cool the cylinder quickly at the end of a run so the settings do not have to be disturbed. The only limitation is not having a liquid which will operate over the entire range of 100 F to 750 F without excessive pressure. A pressure gauge is included in each zone to detect leaks.

The final decision on which method meets the molder's needs will be determined by what type of compound he will extrude to produce a certain finished product. The extrusion or thermal properties of the plastic will determine if cooling is necessary. The allowable tolerance on the finished part will dictate the closeness of temperature control. Capital investment, future possibilities, maintenance costs, and supervision (automatic vs. manual control) are all factors which must be considered in the selection.

References:

(1) U.S. Patent 2,433,936 — H. T. Tornberg
(2) U.S. Patent 2,522,365 — E. S. Greene
(3) U.S. Patent 2,541,201 — H. E. Buecken
(4) U.S. Patent 2,721,729 — J. W. Van Riper

★★

MOLDING CYCLES

Edited by Louis Paggi, *E. I. du Pont de Nemours & Co., Inc.*

Planning the Injection Mold

Louis Paggi
E. I. duPont de Nemours & Co., Inc.

MUCH OF THE COST of running a molding plant can be directly attributed to the considerable amount of experimental work involved in geting the average mold into production. Granted that some of this work is necessary to establish conditions for production of top quality moldings at a minimum cost, a considerable portion of this work can be eliminated with careful planning prior to the construction of the mold.

The following breakdown of the features of a mold may serve as a guide to good construction.

The Sprue Bushing

Does it have sufficient taper to insure positive extraction?

Bear in mind that the greater the diameter of the sprue, the greater will be the overall shrinkage away from the bushing and therefore, easier it will be to extract the sprue. To insure positive extraction, a $\frac{1}{4}$" diameter sprue with a taper of as much as a 10° included angle may be required, whereas a $\frac{5}{8}$" diameter sprue may extract easily with a taper of not more than 3° included angle.

If the part to be produced will require a relatively long plunger-in time because of the necessity of holding "flats" etc., the bushing should have a more generous taper than when molding with a short plunger time.

Is the volume retention of the sprue bushing sufficient to hold non-uniformly heated material emerging from a poorly controlled nozzle?

When molding with hand loading inserts or when operating with front cylinder heats near the degradation temperature of the material, the volume of the sprue should be greater than usual.

Cold Slug Well or Sprue Puller

Is it a good design that will avoid erratic operation?

The undercut annular ring type is a good cold slug well but a poor puller. The "sucker pin" and "Z" types are the best pullers but are not good cold-slug-wells. These considerations will assist in selecting the design best suited to each particular case.

Runners

Are they designed according to the following order of acceptance? (1) Full round, (2) square or trapezoidal or (3) half round or flat?

The full round runner is the most efficient and smoothest flowing and should be used wherever possible. This is particularly true at the junction of the sub-runner and gate where it is desirable to draw material from the center of the melt stream.

Are runners too small, too large, too long or too short?

The correct size runner can only be determined by experimental procedure. However, the following basic rules always apply:

1. Large runners are necessary
   - (a) when low material temperatures are used.
   - (b) when material is required to travel a long distance
   - (c) when high cavity pressure must be developed to minimize shrinkage.
   - (d) when molding parts of heavy cross-section on long cycles.

Unnecessarily large runners should not be used if we are to avoid overtaxing the plasticating capacity of the machine and accumulation of large quantities of rework material.

2. **Excessively long runners should be avoided because they may result in**
   - (a) loss of pressure to remote cavities.
   - (b) need for higher material temperatures.
   - (c) waste of material.
   - (d) unbalanced filling of the mold.
3. **Extremely short runners should be avoided because they may result in**
   - (a) non-uniform temperature of material entering the cavity.
   - (b) surface defects.
   - (c) production of highly strained parts.
   - (d) ejection difficulties.
   - (e) flashing.
4. **Is the size of the runner stepped down when the flow is split into more than one stream?**

Unbalanced filling of a mold is often due to failure to reduce the diameter of the runner when branching into more than one stream. It is very important to build up back pressure as the material flows toward the cavities.

Gates

Has the preferred design been chosen?

The gate is an important feature of a mold, and its design should be chosen to suit the part being molded as well as the operation of the mold. For example, if the molded parts must be carefully handled to avoid scratching, the gates must be large enough to permit ejecting the shot in one piece so that parts may be carefully degated. If knock-out marks cannot be tolerated on the surface of the part produced, the gate must also be large enough to permit ejecting the part via the runner and gate. If a very large number of cavities are to be handled on a very short cycle and parts may be roughly handled, tunnel or sub-parting line gates may be chosen.

If the cavity covers a large projected area, a fan gate or a flash gate may be chosen. This is particularly true for thin walled cavities. If surface flow marks or excessive stressing at the region of the gate are likely to be a problem, the gate should be generously radiused into the cavity. When the cross-sectional area of the gate to each cavity of a multi-cavity mold is so great as to prevent the build-up of sufficient back pressure necessary for smooth balanced filling, a tab gate may be employed. A good general rule for gate land or length is to hold it to an absolute minimum. For example, the gate should be just long enough to accommodate the desired flare or radius. It should not be a miniature runner.

(Please turn to Page 147)

HPM

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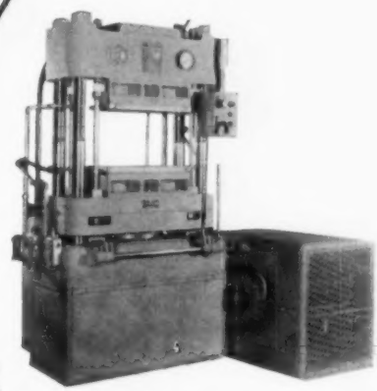

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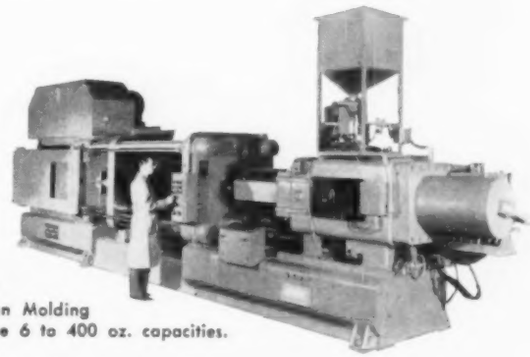

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Unlike many anniversaries that are built to exaggerated proportions, H-P-M is entering its eighty-first year with a minimum of interest in the past. Instead our research and development have geared our efforts to a program for the future. We like to feel that throughout our long and varied experience we have learned to anticipate the needs of the many industries with which we work. It is their future that guides our planning and our policies for the days ahead. This thinking has traditionally guided H-P-M to its present position as a leader in the hydraulic industry. Our goals will be changed only to provide more and better service to the industries we serve.

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Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

RESEARCH DETERMINES CHEMICAL RESISTANCE OF DOW PLASTICS

A typical test under way in the Dow Plastics Technical Service laboratory. This "dunking machine," designed by Dow technical men, tests finished plastics moldings under accelerated use conditions. Any cycling schedule desired can be established on each of its five stations.

ABILITY OF DOW PLASTICS TO WITHSTAND ATTACK BY MORE THAN 350 CHEMICALS TESTED

Industry has recognized the important role of plastics. And, as the range of application possibilities increases, the chemical resistance of these plastic materials becomes critical. The ability of a plastic to withstand chemical attack by certain specific reagents often determines the selection for a given application.

The Dow Chemical Company, as a major supplier of plastic materials to industry, has recognized this problem. Under the direction of Dow Plastics Technical Service, a program of exhaustive tests has been under way for a number of years to provide fundamental data on the chemical resistance of all Dow plastics. More than 350 different chemicals and food ingredients, for example, have been tested to determine their effect on the numerous Styron® formulations. Similar data has been collected on Saran, Ethocel®, Styrex® 767, and Polyethylene.

This data has proved invaluable to manufacturers in making a proper selection of plastic materials for specific applications. Plastiatrics studies and research continue in this and similar areas in an effort to find practical solutions to problems in plastic applications. For your copy of "Chemical Resistance of Dow Plastics," write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. PL 1543J.

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- STYRON 440 (Heat Resistant)
- STYRON 480 (Extra-High Impact)

HEAT RESISTANT
- STYRON 683
- STYRON 700

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Action— By Your National Organization

"The objects of the Society shall be to promote in all lawful ways the Arts, Sciences, and Engineering Practices and Standards connected with the utilization of plastics."

The Plastics Engineer and Professional Status

Jules W. Lindau, III

WE ARE ALL FAMILIAR with the growth of our industry and statistics at this time would not contribute to the thought that is of importance in this topic. Whether or not we are all familiar with the canon of ethics for engineers, it would certainly be valuable to repeat that foreword to the philosophy by which we are all basically bound.

"Honesty, justice and courtesy form a moral philosophy which, associated with mutual interest among men, constitutes the foundation of ethics. The engineer should recognize such a standard, not in passive observance, but as a set of dynamic principals guiding his conduct and way of life. It is his duty to practice his profession according to these canons of ethics. As the keystone of professional conduct in integrity, the engineer will discharge his duties with fidelity to the public, his employers and clients, and with fairness and impartiality to all. It is his duty to interest himself in public welfare and to be ready to apply his special knowledge for the benefit of mankind. He should uphold the honor and dignity of his profession and avoid association with an enterprise of questionable character. In his dealings with fellow engineers, he should be fair and tolerant."

It is assumed that we are all observing this philosophy, but the condition of our Society makes it necessary for us to prove that we are not only observing the philosophy of these ethics but also are capable, in the eyes of our community, to qualify for the title under which we practice. A model law has been proposed and accepted in the majority of the states of our country. Under this law the engineer who has qualified for the title may practice within the limitations of this code.

The statement of the law indicates as follows:

"In order to safeguard life, health and property and to promote the public welfare, any person in either public or private capacity, practicing or offering to practice engineering, shall be required to submit evidence that he is qualified so to practice and shall be registered as herein provided." This code of law also states that it shall be unlawful for any person to practice or offer to practice in the state or to use in connection with his name or otherwise assume, use, or advertise any title or description tending to convey the impression that he is a professional engineer, unless such person has been duly registered under the provisions of this code.

Public Health and Safety

Our industry has grown to the point where we find it necessary to have men of professional status acting as professional engineers under the terms of this model code of laws. We do perform services that are in the interest of public health and safety. It is within the scope of our professional activity to be responsible for the safety of personnel in plants under our jurisdiction, as well as to be responsible for the economic existence of the organizations with which we are professionally associated. The model law has taken these factors into account in other spheres of engineering. It covers the qualifications for registration as a professional engineer. This registration does not control the sphere in which the person entitled to that registration shall be limited. It does consider that the individual carrying the title will live up to the canons of ethics for engineers and thus limit himself to work in which he is capable of performing his professional duties effectively.

The practice of engineering under the model law means any professional service or creative work requiring engineering education, training and experience. It includes the application of special knowledge of the mathematical, physical and engineering sciences to such professional services or creative work as consultation, investigation, evaluation, planning, design and supervision of construction for the purpose of assuring compliance with specifications and design, in connection with any public or private utility, structures, buildings, machines, equipment processes, works or projects.

Professional Qualification

This definition covers every area of engineering science to which the title can be applied. The minimum qualifications for registration as a professional engineer include graduation in an approved engineering curriculum of a school or college approved by a State Board of Engineering Examiners, with a specific record of an additional four years or more of experience in engineering work that is satisfactory to the Board. When evidence presented in application for registration does not appear to the Board to be conclusive, the applicants may be required to present further evidence for consideration of the Board

(Please turn the page)

DUES—WHO'S?

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Jas. R. Davidson
Executive Secretary

Professional Engineering . . .

(Continued from preceding page)

and may also be required to pass an oral or written examination or both as the Board may determine.

Another method of qualification is a record of eight years or more of experience in engineering work of a character satisfactory to the Board indicating that the applicant is competent to practice engineering and successfully passing a written or oral examination designed to show knowledge and skill approximating that attained through graduation in an approved four years Engineering Curriculum.

A third method of qualifying for registration is a specific record of twelve or more years of lawful practice in engineering work of a character satisfactory to the Board of Engineering Examiners, indicating that the applicant is competent to practice engineering, if the applicant is not less than 35 years of age.

Our specific interest is in having practicing professional engineers in our Society registered in the state or states in which they practice. From the description of methods of qualifying for registration, there should be a number of our members at the present time who would be capable of qualifying for registration without additional examination, but solely upon their recognized capability.

For those individuals who have qualifications, but would still require examination, our Society should be the source of examining data to present to the various State Boards of Engineering Examiners. It would therefore be of considerable advantage to each of our sections to investigate the law in the state in which they are located and to discuss this topic with the members of the State Board of Examiners who would be responsible for approval of registration.

The Society of Plastics Engineers will prepare model examinations that it feels pertinent for qualifications for professional engineering status. This is one of our most important projects and should benefit the Society.

Cadillac Opens New Office

Cadillac Plastic & Chemical Co. announces the opening of a sales office at 500 Santa Fe Building, Dallas, Texas.

Ernie Dourlet, formerly with Rohm & Haas, has been appointed sales representative in charge.

The Dallas sales office is Cadillac Plastic's eighth. It will warehouse plastic stocks for speedy delivery to users in the Texas, Louisiana, Oklahoma, New Mexico area.

Quality Control Book Brings Honors

Larry Debing, the editor of SPE's Technical Volume I, "Quality Control for Plastics Engineers," and two of the contributors were given the following laudatory write up in the Monsanto house organ "Poly Press."

"The Society of Plastics Engineers, Incorporated, has announced the publishing and sales release of a new technical volume entitled "Quality Control for Plastics Engineers" edited by Dr. Lawrence Debing, general superintendent of the plant laboratories for the Plastics Division. Sponsored by the SPE, the book contains various chapters written by experts in the field of statistical quality control, including notable contributions by Ed Harrington, scientist, and Jack Hinchen, superintendent, planning control.

"The first in the series of technical volumes committed to the goal of spreading technical information on plastics, the project was organized by the SPE Quality Control committee under the chairmanship of Dr. Lawrence Debing and co-chairman, Ed Harrington.

"Dr. Debing states in the introduction that the theme which most accurately typifies the new science of Statistical Quality Control, is reflected in the phrase "quality can not be inspected into a product, it must be built in."

"But along with these new methods came another contribution of greater value — a new philosophy of inspection — which was to control a process by examination of the product, rather than to control the product alone. Of course, some of this philosophy had been going on for many years, but not nearly so effectively as now possible through S.Q.C. methods. The logic is simple and convincing: the more adequately the manufacturing processes are controlled, the less is the likelihood of scrap and rejects.

Editor L. Debing

"The basic methods of S.Q.C. are described, including control charts, process capability studies and specifications, sampling methods to assure adequate inspection, correlation, and experimental design. Additional material has been presented in several of the chapters in the book beyond that initially published in the SPE 'Journal.'

"This book cannot possibly describe all the methods of S.Q.C. and new ideas are developing every day, but it should provide an effective working program in the many plants which have not yet benefited from the advantages of S.Q.C.," said Dr. Debing.

The National Council of SPE passed the following resolution:

"Resolved that National Council, Society of Plastics Engineers, Inc., in assembly this 4th day of April, 1957, expresses gratitude of the Society to Dr. Lawrence M. Debing and his associates for having completed successfully the writing and editing of Volume I of the SPE Engineering Series, 'Quality Control for Plastics Engineers.'"

SOCIETY OF PLASTICS ENGINEERS, INC.
34 East Putnam Ave., Greenwich, Conn.

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Editor Ernest P. Moslo

Mr. Leo Edward Ryan, president of Monsanto Canada Limited, was born in Montreal on October 24th, 1909. He is the son of the founder of the company, the late Mr. Leo G. Ryan who was a prominent chemical executive of this city.

Elected president of Monsanto Canada Limited in 1955, Mr. Leo E. Ryan has been associated with the company since its inception in 1945. He is also president of Monsanto Oakville Limited, a vinyl sheeting, film and plastic coated fabric producing subsidiary of Monsanto Canada Limited.

He is also president of Wingate Chemical Company Limited, Strong Cobb of Canada Limited and vice-president of Betz Laboratories Limited.

Leo E. Ryan

Why is a Plastics Engineer?

Leo Edward Ryan
Monsanto Canada, Ltd.

WHY is a company in the plastics business? Why am I a plastics engineer? What are our duties, obligations and desires?

Our actions in business every day imply answers to these questions. The correct answers become obvious to anyone who lifts his head from the welter of daily problems to think through the answers to these questions.

"A company is in business to make a profit". This blunt and forthright statement can be expressed in more modern terms with broader implications as "a company is in business to make a maximum return on its investment over the whole life of that investment".

The implication now is maximum efficiency in the performance of labour, in the planning by management, in the use of materials, machines and capital. To maximize return, there must be no waste.

This performance must continue "over the whole life of the investment". A machine may be depreciated in ten years; a corporation continues in perpetuity. We must render maximum service to our customers or they will abandon us for a more obliging competitor, leaving us with a wasted asset. Prices must be fair. If too high, the customers can't afford to buy what they would like, or they buy elsewhere. If too low through indiscriminate price cutting, the company's own profit and return become unhealthy.

So we see that in the long pull, by seeking maximum return through maximum service and maximum efficiency a company fulfils its duty to its customers, its employees, its shareholders. These people are the public whose common good is its reason for existence.

A good plastics engineer works for the same goals as his company. In fact, his training particularly qualifies him to contribute in directing the efficient use of materials and facilities. As his organization prospers, he can expect to receive a fair return in salary and satisfaction in proportion to his contribution to the whole. Hard work, ethical behaviour, professional competence do not go unrecognized.

At this point you will perhaps pardon me if I say a few things about Canada because it is my home and the business climate I know best. I think it is pertinent too because Canada, like the plastics industry itself, is growing rapidly and suffers all the same problems attendant upon rapid growth.

Plastics in Canada is now a 150 million dollar a year business at the manufacturer's level. It has grown in recent years at erratic rates, from nothing to 80% in any one year.

Don't think it is easy to keep pace with a prodigy like this. Not only is it changeable but it is made up of many many products each of whose total demand is much smaller, about 6% of the demand for a like item in U.S.A.

Competition is tougher because production runs are short and because Canadian tariffs on plastics are very low. Manufacturers in Canada must and do meet prices on world markets.

As to the future in plastics, no one really doubts that this brilliant meteoric industry will achieve new heights. New applications, new uses, brand new polymers, have and will continue to arise from the efforts of these creative men working together. Their enthusiasm is the catalyst of progress.

Why am I, an engineer, in business? To render service to all mankind, wherever and whoever they may be. By fulfilling my obligations in my daily work, I serve them all and to my own best interest.

NEWS of the industry

Housewares Design Contest Winners

Competition Designed To Upgrade Plastics Products

Designed to lend active, tangible support to a program for promoting correct design and proper application of plastics in consumer products, the Koppers Housewares Design competition winners for 1957 were announced at a ceremony held April 2nd in Pittsburg.

First-prize winners were: Flambeau Plastics Corporation of Baraboo, Wisconsin, (in both Class I and Class II); and Loma Plastics, Inc. of Fort Worth, Texas, which took a first-prize in Class IV and also won the "Best of Competition" award.

Loma Plastics announced that its two-year scholarship award would go to Carnegie Institute of Technology, Pittsburgh, Pa.; and the one-year scholarship would be given to Alabama Polytechnic Institute, Auburn, Alabama.

The Illinois Institute of Technology, Chicago, Ill., will receive one of the Flambeau Plastic Corporation's one-year scholarships, and the other will go to the Layton School of Art in Milwaukee, Wis., officials of Flambeau said.

All scholarships are awarded in the name of the winning molder to accredited schools of design selected by the molder. Students receiving the scholarships are selected by the schools.

Plastic housewares entries submitted in the competition by these molders were judged as best in design, quality and imagination among the 223 entries submitted by 67 molders.

Plaques for Honorable Mention and Most Original items were awarded, also, in three of the competition's four classifications by a judging panel consisting of Dr. Jesse H. Day, Editor, S.P.E. Journal and Member of the Society of Plastics Engineers; Jay Doblin, Director, Institute of Design, Illinois Institute of Technology and President of the American Society of Industrial Designers; and Dr. Mabel A. Rollins, Head, Department of Economics of the Household and Household Management, Cornell University.

In Class I, Honorable Mention was awarded to Federal Tool Corp. of Chicago, Ill., and Most Original to Brown & Bigelow of St. Paul, Minnesota. Honorable Mention in Class II was awarded to The Plas-Tex Corporation of Los Angeles, Calif., and Milmour Products Co. of Chicago, Ill., received the award for Most Original.

No Awards In Class III

Republic Molding Corp. of Chicago Ill., was awarded Honorable Mention in Class IV and Travel Aids Co. of Brooklyn, N. Y., won the Most Original Award in this classification.

Although the competition included a Class III (decorative product of either polystyrene or polyethylene), no awards were presented this year in this classification.

Easton Changes Name

The name of Easton Plastic Products Co., has been changed to Mannesmann-Easton Plastic Products Co.

Carbide Name Change

On May 1st the name of Union Carbide and Carbon Corporation was changed to Union Carbide Corporation and the name of the division, Carbide and Carbon Chemicals Company, was changed to Union Carbide Chemicals Company.

Kempf Joins Furane

John Kempf has joined the technical staff of Furane Plastics, Incorporated, as Product Development Manager of Adhesives and Coatings.

An outstanding authority on epoxy resin systems, Mr. Kempf has been Associate Director of Research at U. S. Stoneware Corporation and Process Engineer at de Haviland Aircraft Company in Toronto, during the past ten years.

He will concentrate on new product development and coordinate laboratory developments with field applications. Because of his broad experience as a plastics engineer Mr. Kempf will follow through on important developments related to aircraft, missiles and chemical industries.

Foam King Personnel

Foam King announces the following personnel changes: Mr. Harriman H. Dash, formerly Research Director has been appointed to the position of Technical Director. Mr. Philip C. Daidone has been appointed to the position of Research Director. The position of Vice-President in Charge of Engineering has been vacated. Mr. Joseph J. Hirsh, formerly holding this position has been retained by the company as an outside Independent Consultant.

Noma Lites Promotions

Noma Lites, Inc. of 55 West 13th Street, New York 11, New York, has announced the following change in the status of their Holyoke (Mass.) Plastics Division.

Effective February 1, 1957, the Plastics Division became a subsidiary of Noma, to be known as the Holyoke Plastics Corporation.

The new corporation will specialize in custom molding—both compression and transfer.

George W. Martin, General Manager; Edward F. Duda, Plant Manager, and Richard H. Fournier, Assistant Plant Manager—have been named President, Vice-President and Treasurer respectively.

Fox Director at Mellon

Dr. Thomas G. Fox, who has distinguished himself by his investigations in polymer chemistry, has been appointed an Assistant Director of Research in Mellon Institute, according to an announcement by General Matthew B. Ridgway, Chairman of the Institute's Board of Trustees. Dr. Fox, who expects to join the Institute on June 1, will head the programs of polymer research in the institution. He is presently a research executive in the Rohm & Haas Company, Philadelphia, Pa.

Dr. Fox is best known professionally for his research achievements on polymerization and kinetics, on dilute solution studies of molecular structure and thermodynamics, and on the physics and physical chemistry of amorphous and crystalline polymers in bulk or in concentrated solution.

AROUND THE WORLD

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UNITED STATES
ELECTRICAL MANUFACTURING

March, 1957

Abstracter: Bennett Nathanson

Developments in Polyethylene Insulation—*Alex E. Javitz*

This article is an excellent review concerning present and potential wire and cable applications for the various polyethylenes and polyolefins. It lists the existing design limitations for polyethylene wire and cable insulation, advantages of linear and modified materials, such as the polyolefins, and the characteristics of irradiated polyethylene. The limitations of the higher density materials, and the irradiated types, however, are not overlooked. Field use experience and general design problems, as well as a discussion of standards for polyethylene wire and cable insulations, are gone into thoroughly.

(This article, which actually is an extension of a speech presented at the Symposium on Polyethylene Wire and Cable, January 22, 1957, AIEE Winter Meeting, would be interesting to all SPE members.)

April, 1957

Characteristics of Metal-Clad Laminates—*D. S. Haynes, National Bureau of Standards*

This article deals with the results of a Navy Bureau of Ships-sponsored project to develop design data on several types of metal insulated laminates for printed-circuit work. Specifically the report deals with tests conducted on (1) the current-carrying capacity of etched copper conductors, (2) resistance measurements on samples having a variety of protective coatings, and (3) dielectric properties of metal-clad laminates at various temperatures. Seven groups of phenolic laminates, one of epoxy glass-mat, a nylon-base phenolic laminate, and a styrene copolymer (the latter without coatings) were included.

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ARGENTINA
PLASTICOS

January-February, 1957

Abstracter: John B. Ballard

Polystyrene is Being Produced Locally—*Editorial*

This editorial reports a reception in December, 1956, celebrating the beginning of production in a new polystyrene plant operated by Monsanto Argentina, S. A., in Zarate, province of Buenos Aires.

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AUSTRALIA
AUSTRALIAN PLASTICS & RUBBER JOURNAL

January, 1957

Abstracter: Albert Lightbody

Direct Measurement of Dynamic Bulk Modulus

The U.S. National Bureau of Standards has reported an instrument capable of measuring bulk modulus under changing pressures, of many types of materials. Frequency may be varied and pressures up to 1000 atmospheres can be imposed on the alternating pressure.

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FRANCE
INDUSTRIE des PLASTIQUES MODERNES

March, 1957

Abstracter: Hans Mayer

Pliable Molds for Polyesters — *J. Devorsine*

Plastisol molds for epoxy resins are known. This type of mold was not usable for polyesters due to the extent of exothermic heat created in the course of the curing process and the action of the styrene monomer on the plastisol mold.

The Vinatex Ltd. has compounded a vinyl resin which will be suitable for the cast-molding of polyesters. The material will withstand temperatures of 170 to 180 degrees centigrade without loss of flexibility and will not be affected by the styrene content of the polyester resin. It is stated that a mold, made from this material, will stay elastic for approximately 30 casts and can be reconditioned by a heat treatment for another cycle of operation.

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GERMANY
KUNSTSTOFFE

March, 1957

Abstracter: Anne Schwend

High Molecular Ester Plasticizers — *K. Zoehrer and A. Merz*

Based on a maze of literature spread over the world, this article represents a thorough study of the properties of high molecular weight ester plasticizers, classifying them into five groups: sebacic acid ester, adipic acid ester, phthalic acid ester, high molecular ester plasticizers of unknown composition and epoxidized oils. These products are investigated as to composition, chemical and physical data, technological properties, compatibility, stabilization and testing methods.

Diffraction Gratings on Plastic Films — *Ivar Grave*

An introduction to the principles of optical interference in light technique is followed by a description as to how to make use of interference colors via diffraction gratings for advertising purposes, color effects on glass surfaces, clock and watch dials, jewelry business and other industries seeking to catch colorful effects. In order to develop such diffraction gratings of optical efficiency three factors have to be considered:

1. Considerably increase the narrow angle under which the reflected or

transmitted light can be constantly seen.

2. Guarantee economy through shape and reliable production methods.
3. If necessary, augment the reflective capacity of the grating surface by simple means and protect it against marring.

To 1.: Special arrangement of the grating grooves either crosswise, in concentric circles, or in parallel or superimposed groups augments visibility to the desired degree.

To 2.: Slightly pressing a cellulose acetyl film against a preheated matrix for a few seconds, then chilling both mold and molded film with water will make the grating spring from the mold without difficulty. The working cycle depends on the kind of film used and in particular on the profile of the grooves. Flat grooves are considerably less moldable.

To 3.: Metal plating under high vacuum of the grooved surfaces permits an increase of the reflected-light-capacity to that of ordinary mirrors, i.e. up to 80% and more. The sensitive surface of such a diffraction grating can be effectively protected either by a thin glass plate or another thin cover film cemented to the edges of the grating and hardly impairing the reflected-light-intensity of the grating.

PVC-Acetate Plastisols and Organosols—*Wolfram Riese*

The peculiar features of PVC-acetate co-polymer dispersion products such as plastisols, organosols and plastigels, methods of production and application and their usefulness in plastics coating of metals, textiles, papers as well as for expanded products are reviewed. Since development of plastisols and organosols has in no way reached the final stage yet, attention will continue to be paid to such products and their working methods.

Exhibition of and Conference on Plastics at the IVe Salon de la Chimie

A report on the successful bi-annual plastics exhibition in Paris and some of the papers presented at the 29th International Congress for Industrial Chemistry in Paris, in November 1956. The symposium on grafting reactions of polymers is reviewed in more detail.

German Standards

The draft for standardization of "Welding of Soft PVC" as proposed by the German Association for Welding Technique and the Standards Committee for Plastics is reprinted for discussion and contest. These directives shall give a survey on the execution of different welding methods and shall serve as basis for orders, execution and acceptance of welded goods from soft PVC.

Sintered Fluorocarbon Coatings

Excerpt from the article by G. Bartczak in Modern Plastics, September 1956.

KUNSTSTOFF-RUNDSCHAU

March, 1957

Abstracter: Leo Fischer

Epoxy Resins in Patent Literature Part II—*G. Tewes*

This second part of the epoxy articles discusses esterification of epoxy resins. The numerous hardening agents and their chemical reactions are fully described. Nitrogen containing epoxides, chiefly with amino groups, are proncipally used in conjunction with epichlorhydrin. Amides are also used as hardeners such as dicyandiamide. In room temperature cures ethylenediamine or diethylenetriamine should be used since the aromatic amines are too slow. Isocyanates are indicated as very promising. Hardening can also be achieved with monomeric, unsaturated polymers.

The term epoxy is used quite broadly in this article and the discussion includes resins in the isocyanate and polyester groups. Polymerizable resins of the epoxy family are generally obtained in one of the three methods: (a) Esterification of a resinous epoxyphenylglycidyl ether with unsaturated carbonic acid and the conversion of the esterified epoxy resin with vinyl monomers. (b) Partial esterification as above and conversion with vinyl monomers ending up with complete esterification. (c) Conversion of unsaturated carbonic acid with vinyl monomers and esterification of the reaction product with glycidyl ether. All these reactions are extensively documented with patent references.

Manufacture, Composition and Characteristics of Polyethylene and Other High Molecular Polyolefins — *Hans Hagen*

The first step in producing polyethylene is the manufacture of ethylene. A number of methods are discussed. When using the petroleum cracking process there is a yield of only eight to ten percent. As requirements for ethylene have increased processes whereby yields are at least fifty percent become more practical, such as the mixing of gases in cracking towers. The ethylene for polyethylene production must be especially pure if the Ziegler process is used.

Generally high pressure polymerization is necessary to attain long molecular chains. To arrive at the high monomer concentration, temperatures of 200°C and pressures of 500 to 2,000 atmospheres are required. Some discussion of the ICI process and extensive patent references are presented indicating the production of polyethylene up to a molecular weight of 50,000. The Ziegler process operates at room temperature and no pressure. Diethyl aluminum hydride and titanium tetrachloride are added to the ethylene. The temperature rises to 70°C in one and a half hours and the polyethylene is formed. Chains up to 3,000,000 molecular weight can be formed. By varying the co-catalyzers the chain length can be varied. Although it seemed at first that the Ziegler method would be lower in cost the difficulty encountered in purifying the polyethylene and the danger of a runaway reaction requiring careful and expensive controls has tended to keep the price up.

The Ziegler technique can also be applied to the polymerization of other monomers, as thoroughly analyzed in Natta's writings and patents. Natta's fundamental polymerization principles are described and their relation to rubber production is analyzed. Phillips Petroleum Company's technique uses chromeoxide and aluminum silicate and temperatures of 150°-180°C at 50 atmospheres in a continuous operation or an agitated vessel. Molecular weights of 50,000 are obtained and the density is higher than obtained in the Ziegler process.

Graphic Calculations of Cylindrical Plastic Boxes—*H. Gut*

This is a very interesting and thorough article giving extensive formulations and graphs and other calculating aids to determine the weight, thickness, size and volume of cylindrical boxes. Formulae for calculating the most efficient use of mold areas and required packaging units are also presented.

DER PLASTVERARBEITER

January, 1957

Abstracter: Leo Fischer

Practical Experience With A High Speed Self Regulating Extruder — *E. Beck*

This article is concerned with the problem of obtaining large production with extruders having a small diameter screw. A high energy input must of course be supplied. It is necessary to melt the plastic mass rapidly enough to attain a fluidity that will not clog the die. Intensive mixing of the plastic serves the same purpose as intensive heat as far as softening action goes. Only a small percentage (2.5%) of the power transmitted to the screw is required to push the molten plastic mass

through the die. This extra power can be utilized to soften the plastic mass by greatly increasing the speed of the screw. The relationship of temperature and pressure of the plastic in the die head is controllable by the fact that as the viscosity of the plastic changes the power requirements of the screw thrust change. Consequently a lowering of the viscosity reduces the speed of the extruder. To compensate for this variability an adjustable throttle at the die end of the screw is built in to obtain proper control of the screw. Switch controls for the motor, material feeder, take off equipment, and pumps are installed. Actual drawings and pictures for application of this system in various extrusion techniques are included.

A New Extruder
—A Commercial Bulletin from Heinrich Koch & Co.

This very interesting bulletin describes a new extruder (DBP 933,185) in which the cross section of the cylinder at the head of the extruder can be varied during operation and thus set up a control for flow and pressure. The controlling device consists of a hydraulically activated movable screw whose end is conical, and fits into another inverted cone. The space between the two cones can be varied by moving one of the cones back and forth, thus controlling the flow orifice. The variable back pressure, and the width of the orifice are read on gauges and the operator can readily make adjustments not only as to orifice width but as to speed of screw and heat input.

February, 1957

Application and Techniques of Isofoams—*H. Baumann*

A formaldehyde solution and a foaming agent are mixed in a portable apparatus, consisting of two pressure tanks, a compressor and a specially designed gun on a cart that can be moved about and used directly on the job. Pressure is maintained at 4.5 atmospheres. This method has been widely used to insulate piping and ducts directly or by building a metal or wooden box around the pipes and spraying into that. In cases where difficulty of adhesion is met the pipes are wrapped with jute. To insulate roofs and walls two layers of a woven material are stretched several inches apart and the foam driven through the web.

An Infrared Spray Gun for Air Hardening Resins—*H. Kalpers*

A spray gun is described which sprays slow drying resins through a ring of infra-red elements attached to the nozzle of the gun. It is claimed that this device produces the least amount of fogging, shortens drying or curing time, produces a minimum of dust, a better flow, a higher gloss and a saving of material. It is also suggested that the heat softening thermoplastics, such as PVC and polystyrene can be sprayed without solvents.

Etalu, a Mixture of Aluminum and Resin—*H. Kalpers*

Adding aluminum particles to various resins imparts unusual characteristics and improvements. Aluminum powders must not be too fine—no smaller than .07 mm and preferably .14 mm. For many applications the most desirable size range is .3 to 1.5 mm. 20% to 60% can be incorporated, to increase mechanical strength. Polystyrene achieves a 60% increase in impact strength by adding 32% by volume of Aluminum powder. Phenolic resins with 53% volume of Aluminum are compared with wood and cotton filled phenolics. A 100% improvement in some specifications was obtained. Other resins used with Aluminum powders were vinyl acetate and polyesters, in casting compression and injection molding.

Insert Pieces in Injection Molds—*Karl Morwald*

In order to obtain a variety of sizes and forms in one mold it is suggested that removable insert pieces be built into the mold. This technique makes it possible to produce several varieties and sizes of an article from one mold. This is especially adaptable to toys where three sizes of the same piece are possible with two inserts. Detailed drawings of several sizes of a measuring cup mold are given.

Applications of Epoxy Coatings — *H. Kalpers*

In the cracking of the very reactive compound, propylene, one of the fractions indirectly leads to epychlorhydrine. This in turn, upon condensation with diphenylolpropane, is one of the methods of producing Shell & Co. Epon. It is emphasized that only in combination with phenols, alkyds, ureas and melamines is a baking lacquer produced and esterification with proper fatty acids and melamines and ureas produces an air drying lacquer. A great variety of specifications are possible by varying the chemical combinations. It is advised that before coating with epoxy lacquers the metal must be mechanically cleaned with steel brushes or sand blasting. In Germany epoxy coatings are most widely used in the beer industry where, as a result of such coatings, production has been increased and spoilage greatly decreased, and the quality of beer has improved. The techniques of lining kettles, pipes, pumps and valves is described.

Plastic Toys Have Arrived — *K. Brockhaus*

A full discussion of the toy industry in Germany is presented. The resins used, the techniques applied, mol-methods used and production and import and export figures are given. Many pages of illustrations of new toys are also included.

HOLLAND
PLASTICA

February, 1957

Abstracter: W. P. ter Horst

Inorganic High Polymers—*J. Zernike*

Silicates (ordinary glass, mica and asbestos) are among the best known of inorganic polymers. Previous articles have been devoted to silicones and plastic sulphur. In the present study a survey is given of the entire field, mentioning among others, violet and black phosphorus, certain borates and phosphates, silicon sulphide, boron nitride and phospham. Suggestions are given for further work in this field.

ITALY
POLIPLASTI

November-December, 1956

Abstracter: Alfred L. Alk

The Plastics Industry in Australia—*Giorgio Anglesio*

A review of the present state of the Australian Plastics economy.

Silicones in the Plastics Industry — *Luigi Parrocchetti Piantanida*

"Silicone" is a generic term for an organic-like molecule in which the backbone of carbon atom is replaced by silicon and oxygen. These hybrid substances with familiar molecular structures have unfamiliar physical properties and have found wide application because of their notable thermal stability, chemical inertness, water repellency, resistance to extremes of temperature, etc. Silicones are available in a multitude of physical forms. As mold release agents, their low surface tension allows a thin film to form preventing sticking and making cleaning easier, and may be applied by a variety of methods. As resins for laminating with glass or asbestos fibers they are resistant to high temperatures and humidity, have excellent dialectric properties, are Class H insulators and can be fabricated with common tools. Silicone molding powders may be handled in the same equipment and conditions as phenolics but must be post cured in an oven at temperatures approaching 250C. Silicone foams having the same physical properties as the solid

materials are used in laboratory work, in aircraft fabrication and other special applications. Silicone adhesives are used where extremes of temperature are likely to be encountered. As resin additives they increase adhesion to glass fibers, increase resistance to humidity of phenolics, prevent water damage of polyester surfaces and impart better extrudability to polystyrenes and polyvinyls.

Gaskets and Washers in Vinyl Resins — *Ottorino Motta*

Details of production by Goodyear Tire and Rubber Company of types of refrigerator and automotive gasketing and other extruded products from PVC using Rohm and Haas plasticizers.

Blown Extruded Thin Walled PVC Film — *Arturo Trevisan*

PVC has excellent characteristics for being worked by extruder, calander or press. It was thought that PVC films could be produced by methods already developed for other materials such as cellophane or cellulose acetate, but these turned out to be too complex, delicate or difficult and were put aside. Calendering required too costly equipment and too many operations besides not yielding thin enough films. The sheets had to be press polished to be transparent and in order to be made into bags, required backseaming. It was decided to produce a tube and to form bags using available automatic sealing machines. Development was undertaken culminating in the preparation of blown extruded PVC film from .0004" to .004" in thickness by means of special equipment and carefully prepared compounds. Granular compound is fed to a single screw extruder where it is flexed and extruded as a tube through a circular die at a wall thickness of .080" to .120" through the center of which air is introduced. The tube is then collapsed and pinched by a pair of variable speed rollers which limit the escape of the internal air and develop the required thickness of the tube walls. The use of a 90 degree crosshead die required the material to remain too long in the die and caused burning. Next procedure was to develop a straight die for horizontal extrusion and a vertical extruder for use with a straight die. The horizontal extruder which gave best results had a double flighted 1.8" diameter screw; 1:17 Le/D ratio; 2:1 compression ratio and a straight die with a 1.96" ID and 2.00" ID (49mm and 50mm). With such a die it was possible to obtain tubing from 4.8" to 14" layflat width. A screw speed of 20 to 40 RPM produced 22 lbs per hour. The temperatures usually used were 150 degrees on the back of the screw, 170 degrees on the head and 175 on the die. Because of the tendency of PVC to oxidize it was necessary to maintain the temperature of the die within 2 or 3 degrees. Two opposing phenomena were observed: opacity was dependent upon insufficient temperature and blocking was caused by excessive temperature. The vertical extruder has been studied only in the extrusion of PVC. A special feeding section allowed the use of either dry blend or granules, plasticized or rigid, to be charged to the extruder screw. The extruder was heated by a cast iron sleeve with a spiral passage for refrigerated air. It was possible to make films from .0004" and, with special compounds, to .002". The experimental machine having a 1.8" screw produced 17.6 to 26.4 lbs of rigid film and 22 to 33 lbs. of plasticized PVC film per hour with a maximum layflat width of 24". It is believed that a larger extruder will allow wider films to be produced.

January-February, 1957

Plexigum: Extrusion Processing

Plexigum is a polymethylmethacrylate which may be injection molded. It reaches the consumer in the form of chopped rods, colored or clear, and ready for processing. Close attention must be paid to cleanliness. Dust or particles of other plastics handled in the same machines or molds will appear as defects in the finished articles. It must be pre-dried at 90-100 C for about eight hours or until the humidity is brought down below 0.1%. A single screw extruder of 15 to 1 or greater length is best adapted to extrusion. Non-ferrous metals are not desirable. Screw and barrel need not be stainless steel or chrome plated. A single flighted constantly increasing compression screw is preferred. Operating conditions are critical in that the granules must be thoroughly compacted and de-aerated in the screw before being melted, and overheating must be avoided during the process. Use of a vented extruder can minimize the preheating required, and can eliminate many of the problems associated with gasses in the melt. No screens or breakers are required because of the high viscosity of Plexigum. Dies ordinarily used for PVC and Cellulose Acetate may be used without modification. Extrudate has a highly polished surface and must be cooled slowly to prevent roughness, waviness and internal strains. A water bath can be used if properly controlled. Illustrated.

The Use of Plexigum in the Fountain Pen Industry—*Ing. Freiderich*

A detailed discussion of the injection molding of fountain pen parts and the solution of difficulties are transcribed from the proceedings of a conference at the German Assembly of the Fountain Pen Industry.

Expanding Market for Polyethylene Fibers—*Carlo Luserna*

The use of polyethylene as a textile fiber has not been particularly impressive up to the present time. Three American firms, however, have announced their intention of producing, with the Ziegler and Phillips polymers, products which will compete with nylon and saran. Specifically expected use is in the areas of cordage, filter cloths, three dimensional fabrics and normal fabrics. Further production expansion is expected when the lack of resiliance in present polyethylene fibers has been overcome.

The Use of Films and Laminates in Agriculture—*Arturo Trevisan*

During the past three or four years successful experiments have been performed employing low cost films in agriculture. Polyethylene, for example, is most efficacious in the culture of transplants, (i.e. not sown in seed like cereals or grasses) where it retains moisture and nutrients in the soil and inhibits weed growth in addition to separating the fruit from the soil which promotes rot. Developments in the use of polyethylene and PVC films are discussed and illustrated: for row covers, as storage pond and irrigation ditch linings, as ensilage protection.

A .003-.004" polyester-glass laminate has recently been introduced to the Italian market for agricultural use. In large sheets it is being employed to replace glass in greenhouses and cold frames, and as portable screening for field use.

Plastics for Seed Conservation in Agriculture

The factors affecting degradation of seeds between harvest and planting are presented. Plastics and laminates used for protective packaging are described.

Furfural—*P. Cucchetti and A. Galbiati*

A comprehensive examination of furfural; its production from agricultural waste products; its reactions as a chemical; its uses as solvent, extractant, dispersant and in adhesives, disinfectants, mastics and fuels. Its transformation into resins and the properties thereof are also presented. Illustrated with flow sheets and photographs.

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SECTION NEWS

Edited by
Charles P. O'Donnell
Monsanto Chemical Co.
Springfield, Massachusetts

Northern Indiana

New Ceramo-Plastic Materials

Leon J. Page

The members and their guests of the Northern Indiana Section were unanimous in their approval of the talk presented by Mr. J. H. Dubois, vice president of the Mycalex Corp. and former national president of S.P.E., at the March 12 meeting.

Mr. Dubois, who is considered by all to be a pioneer in the field of plastics and materials selection, interjected several interesting personal side lights of his years spent in Indiana which added a lighter touch to the mass of highly informative technical data expounded. The theme of his talk centered around the new ceramo-plastic materials and their unique properties that are especially well suited for service in electrical components and in high temperature service. "Harry," as he was affectionately called by many close friends present; illustrated his description of many uses for this type material with examples of items made of this material finding wide and satisfactory service in industrial and military applications.

The interesting property of an almost identical coefficient of thermal expansion for this material, as compared to steel, grants the desirable ability of reinforcing the ceramo-plastics with steel inserts of any required geometry. The resulting dimensional stability and extreme high strength of items produced in this fashion answer many design problems confronting the modern engineer.

Additionally, a short motion picture film was displayed to show the advantage held by this material over many others used as insulators under hi-load electrical arcing and the resulting high temperatures produced. In the tests shown in the movie, the breakdown caused by heat and carbonization completely eliminated many of the materials subjected to this destructive testing. Only the ceramo-plastic materials were sufficiently able to stand up under these severe conditions to warrant consideration for similar service.

The Northern Indiana Section continued to demonstrate its vitality by announcing a 29% increase in its membership since the last meeting and introducing to the membership fourteen initiates. The efforts to increase the size and scope of this section will continue and hopes are high that so great an increase will be noted again next month.

Paul Haas of the Haas Corp., Mendone, Mich., and Wayne I. Pribble, National Director of the S.P.E., spoke briefly but glowingly of their association with Mr. Dubois and the president of the section reminded all present of the number of technical books published and in use that were authored by J. H. Dubois with especial mention to "Plastics Mold Engineering" co-authored by J. H. Dubois and W. I. Pribble.

Many of the members and guests remained after the regular hours of the meeting to discuss individual problems with Mr. Dubois which was indicative of the value of the information received on this subject.

Kansas City

2nd Seminar Meeting Held

K. A. Kaufmann

The second of a two-meeting education seminar, "Introduction to Plastics" was held by the Kansas City Section of the Society of Plastics Engineers April 4th at Milleman's Restaurant on the Plaza. All speakers were from the local section in this presentation designed for purchasing agents and engineers from companies in Greater Kansas City using plastics. Attendance was about 75.

Phil Fleming of Bendix Aviation and President of the section gave a short introduction and acted as moderator of the session.

W. P. Gideon of Eastman Chemical Products gave an interesting talk on the uses of cellulose acetate and cellulose acetate-butyrate. It was interesting to note that almost all automobile steering wheels are made of butyrate and items as large as children's hobby horses are fabricated from injection molded cellulose acetate.

Harold Holz of Bakelite presented a very complete discussion of the fast growing vinyl field, using slides. The various types and applications of vinyls, ranging from incorporation in chewing gums to flexible floor tile and rigid piping were very clearly discussed.

Howard Hamilton of Monsanto Chemical Company showed some very interesting industrial and decorative uses of polystyrene including back plating and battery cases. He discussed the properties of straight polystyrene versus the higher impact types.

Carl Bontemps of Rohm & Haas showed, with slides and samples, the many applications of acrylics in signs and especially in the architectural field. Also of interest was the greater strength of biaxially oriented sheeting for use in high stress aircraft applications.

Lyle Dean of DuPont outlined many of the industrial and functional uses of Nylon 66 such as gears, bearings and stuffing tube boxes. He noted that in light load applications, such as textiles, no lubrication of nylon parts is required while it often becomes desirable for heavier loadings.

K. A. Kaufmann of Spencer Chemical Company detailed, with slides and exhibits, the market growth, applications and specific properties of polyethylene resins and products.

Alan Donaldson of Bakelite reviewed thermosetting plastics, defining the differences in processing from thermoplastics. He pointed out the higher heat resistance at low cost of these materials.

In all, both sessions of the seminar were vastly successful in attaining the stated aims of (a) acquainting local purchasing and engineering personnel with plastics information and increase prospective use of plastics by their respective concerns; (b) promote interest from prospective members; and (c) provide participation in Section activities for a larger group of members. It is recommended by the Kansas City Section that other sections consider a similar program.

A further note from Kansas City is that the Section is planning to furnish subscriptions to plastics journals to ten branch libraries in Greater Kansas City.

Milwaukee

Talks Given On Molding Tank Bodies, Dinnerware And History of Phenolics

James S. Hearons

The April meeting of the Milwaukee Section was held Tuesday, April 9, at the Ambassador Hotel in the Amber Room at 6:00 P.M., dinner included. About 60 members and guests attended.

The meeting was opened with a short business discussion and Tom Hardeman gave details of the chapter's golf outing held on June 1 in Sheboygan. The highlights of the evening were three talks delivered by representatives of local firms engaged in the plastics industry. George B. Luhman, Jr., Chief Engineer of the Plastics Department of the Heil Company, Milwaukee, Wisconsin, discussed the molding of their Fiberglas reinforced tank and truck bodies. Particular attention was given to the advantages of reinforced truck bodies over conventional bodies from a strength to weight ratio, insulation qualities and corrosion resistance. It was most interesting to learn that reinforced plastic bodies weigh about 20% less than conventional metal bodies and have up to 10% more cargo space with the same outside dimensions. It was a most interesting presentation judging by the active question and answer session at the end of the talk.

Ken Welsh, President of the Kenro Corporation, Fredonia, Wisconsin, and his staff, discussed the molding methods and marketing and advertising connected with their melamine dinnerware line. The Kenro Corporation is just a little over three years old and in that time has gained a national reputation with their dinnerware line. Particular attention was paid to the molding of this product and the problems involved.

The last speaker of the evening, and equally as interesting as the above, was Ralph Bortz, Vice-President of the Plastics Engineering Company, Sheboygan, Wisconsin. Mr. Brotz discussed the history of phenolics and the manufacturing of phenolic molding compounds.

Officers elected for 1957 are as follows: Kenneth F. Charter, President, A. O. Smith Corporation; Thomas R. Hardeman, Vice - President, Hardemann Laminating Co. Inc.; Charles H. Herrick, Secretary, Sterling Incorporated; W. H. Brueggemann, Treasurer, A. O. Smith Corporation; George Gray, Membership Chairman, Cadillac Plastics; Paul West, National Director, Sterling Incorporated; T. Walter Noble, National Director, Decar Plastics.

Section Directors: Charles E. Egan, Owens-Corning Fiberglas Corp., 3 years; A. J. Simmons, Plymouth Industrial Products, 2 years; Harold Hulterstrom, Flambeau Plastics, 2 years; Clarence Stowe, Stowe Plastics, 2 years.

Binghamton

Application Of Electrical Discharge Machining To Mold Cavities

L. N. Chellis

Fifty-five members and guests of the Binghamton Section met for the April 25th dinner-meeting at the Vestal Steak House. We were happy to welcome as guests A. W. Cummings and Bob Whalen of Brilhart Plastics Company, R. C. Kronbach of Elox Corporation, George Rheinfrank and Dr. Howald of Glaskyd Corp., and Ken Swartz of Consolidated Molded Products Co.

An excellent 26 minute sound movie on Elox Electrical Discharge Machining was shown by Mr. George Sinden of Elox Corporation.

Following the movie, our main speaker, Mr. Sol Levites of Hydro Molding Co., Plattsburg, New York spoke on "Application of Electrical Discharge Machining to Mold Cavities." Mr. Levites augmented his very informative presentation with slides depicting some of the applications developed at Hydro for Elox equipment.

A major advantage of this process is that it enables the tool builder to precision machine prehardened mold steel. When certain basic practices are adhered to, tolerances of .0005" can be built into a cavity. Mr. Levites indicated how intricate electrodes may be formed in brass or malleable steel. The electrode must be dressed at intervals during the sinking operation.

A discussion period lasting about an hour followed Mr. Levites' formal presentation.

At the time, final arrangements were made for the Binghamton Section's 1st Annual Dinner-Dance which was held in the Starlight Room of the Carlton Hotel, Binghamton on Saturday, May 18th.

Quebec

Foamed Plastics

Henry Finkel

The important task of educational guidance by the professional societies of this continent was emphasized by Mr. Peter Simmons, national president of the Society of Plastics Engineers, who addressed the regular monthly meeting of the Society's Quebec section. Accompanied by the national executive secretary, Mr. James R. Davidson, the two were accorded a civic reception during the afternoon by Mayor Jean Drapeau, and, after signing the golden book, discussed the possibility of holding the society's annual technical conference in Montreal in the spring of 1963. An estimated 3500 plastics engineers, designers and technicians are expected to attend this convention.

At the dinner meeting of the SPE held in the Queen's Hotel, Mr. Simmons said that the national Society has formulated plans to establish a Plastics Institute in conjunction with one of the American universities, to provide a proper educational background for any young person interested in entering the technical branch of the plastics field. This project is well advanced, and should come into effect within the next two years.

Other ventures by the SPE include the publication of technical books, the regular production of its monthly journal, and the distribution of this journal on a free basis to selected libraries and schools. The Society is composed of 37 regional sections from coast to coast in Canada, the U.S., and Mexico.

The meeting's technical subject concerned foamed plastics. Discussion by four panel members pointed up the specific advantages and complications of each of four different basic materials. Plastic foams are achieved by blowing a plastic compound full of air or gas bubbles. The resultant plastic is very light and unusually strong for its weight. The blown sheet or form can be made hard and rigid like a board, soft and flexible like a fine sponge, or to any intermediate degree.

Herbert Schmalz of Kitchener, Ontario, was the moderator of the discussion, and also spoke on polyurethanes. Ian Goughlin of Belleville, Ontario, spoke of phenolic foams, a low cost material with specialized applications. John R. Charlton pointed up the advantages of vinyl foams, very popular for seat cushioning, and Harry Maranack indicated the advantages of styrene foams, as exemplified by its use in Christmas decorations. All foams have certain advantages in common, the most important being their high insulation values, and their lightness or bouyancy.

Eastern N.E. Scholarship Awarded

Dean of Students Richard W. Ivers of Lowell Technological Institute congratulates Miss Carole Harper of North Chelmsford, Mass., a sophomore in plastics engineering at LTI, on her winning of the $200 scholarship given by the Eastern New England Section of the Society of Plastics Engineers, Inc. At left is Vernon Ure of Pelham, N. H. and at right, Harry Tobler of Putnam, Conn. who received $500 scholarships from the Ciba Company, Inc.

Western N.E.

Thermosetting Materials Report

C. P. O'Donnell

Under the Technical Chairmanship of Mr. William Bentley (Colt's Mfg. Co.), a "Progress Report of Thermosetting Materials" was given to the Western New England Section's membership by General Electric's Mr. Wyman Goss. Speaking after dinner in the Bradley Field Terrace Dining Room, Mr. Goss, who manages G.E.'s Phenolic Products Plant, Chemical Materials Department and Metallurgical Division, discussed recent and projected developments in the phenolics materials field. Touching on new, fast-curing materials (including arc resistant compounds) and powder preheat pros and cons, the speaker also gave a general summary of the progress and outlook in today's thermosetting industry.

The G.E. representative, after giving a brief history on the "workhorse of the industry," as he termed phenolics, pointed out that even though phenolics are one of the earlier plastic materials, they still lead all thermosetting materials sales. Also, in spite of the introduction of many new thermo plastics, they are fourth in sales for all plastics materials.

Though thermosetting materials have been greatly replaced in cabinetry and low voltage electrical items, they have maintained overall sales volume due to constant development and research. According to Mr. Goss, phenolics are still vital, offering ease of fabrication, good dimensional stability and temperature resistance, all at a low cost. He labeled phenolics, "the best buy as a material of construction that is available to American Industry today."

At this point in his talk, the speaker delved into the technical aspects of thermosetting materials, and phenolics in particular, their problems and progress. Particular points covered were: mold erosion problems, printed circuitry, foundry applications, pre-heaters and automatic molding with fast curing cold powder and a new arc-resistant material recently put on the market by G.E.

In relation to mold erosion Mr. Goss explained that this is a problem which is under constant study by materials suppliers. His organization now offers materials with a ten-fold reduction in erosion as compared to that experienced in former materials. Modern, fast-cure powders also have improved the automatic molding picture, and according to the speaker make many present uses of pre-heaters unnecessary. Feed tube problems are also being worked on by materials suppliers and Mr. Goss made several suggestions pointing towards a solution of these problems in molding operations.

Here Mr. Goss gave a detailed description of a new G.E. arc-resistant material. Offering high resistance at low cost, the full technical data on this phenolic was supplied by Mr. Goss. He encouraged inquiries for written data and samples from interested persons.

The talk then went on to the growth of the electronics industry and its impact on thermosetting materials through increasing demands for printed circuitry. Laminates for such applications must offer cold punching properties and resist hot solder, vapor or solvent degreasing, flame, and have high electrical insulation capabilities.

In conclusion, Mr. Goss discussed the foundry resins which have opened new vistas for foundrymen. Speed, low cost and dust elimination factors have attracted the foundries' attention. Mr. Goss remarked on the fertile sales field for automatic compression molding machines offered by foundrymen who have little know-how on the subject but are daily becoming more involved in homogeneous molding material activities.

After an extensive question and answer period, the meeting was closed by the Section President, Mr. Lewis Gustafson (Prolon Plastics).

Southern

Tufted Textiles Back Coating

R. E. Welch & E. O. Redwine

The regular monthly meeting, held on April 15, featured a talk by a local member, Wilfred J. Mohr, Technical Director, Southern Latex Corporation, Austell, Georgia.

Mr. Mohr talked on the subject of "Tufted Textiles" with special emphasis on the types of back coatings employed. Tufted textiles had their inception approximately sixty years ago in Dalton, Georgia, as a handcraft. With the development of high speed machinery, their growth has been rapid.

It is estimated that about 90,000,000 pounds of tufted textiles were produced in 1956 and that 50% of all soft floor covering produced, is tufted.

Mr. Mohr pointed out that the back-coating plays an important part in the wearability of the finished product since without a back-coating, tufts easily pull from the carpeting. About 25,000,000 pounds of rubber and plastics were used in 1956 in the compounding of back coatings, the majority of this amount being rubber, both natural and synthetic—chiefly the GRS type. The high styrene-butadiene type latices accounted for about 4,000,000 to 5,000,000 pounds. Other plastic materials being used or being evaluated for use in rug backing, include polyvinyl chloride latices and vinyl acetate latices. During the course of his talk, Mr. Mohr displayed samples of carpeting backed with the various types of latices.

The chief requirements of a good rug backing were listed as: good ageing, launderability, good heat resistance and resistance to staining and discoloration.

Mr. Mohr's excellent talk was followed by a question and answer session which was indicative of the interest aroused.

Local S.P.E. President, Thomas H. Hart, presided over the meeting and announced that a lounge to be known as the Lockheed Room, will shortly be opened in the Architects and Engineers' building, 230 Spring Street, N.W., Atlanta, Georgia — regular meeting place of the Section. This lounge, to be furnished by the Lockheed Aircraft Corporation, will be available for the use of all members.

Miami Valley

Molding and Applications of Colored Polyester Resins

A. P. Young

The Miami Valley Section met Thursday night, May 2, at the Golden Lamb Hotel, Lebanon, Ohio. The speaker for the evening was Mr. Harry M. Dent, Jr., who is in charge of Product Development at the Durez Plastics Division of Hooker Electro Chemical Corporation.

Mr. Dent's subject for the evening was "Colored Polyester Molding Compounds, Their Applications and Molding Techniques." A few weeks ago a news item was released for publication in the trade journals and newspapers announcing the advent of Durez into the polyester colored molding compound field. Large scale production is expected to begin this fall, following completion of a $570,000 project. Mr. Dent reviewed the research and development which had gone on to make this announcement possible, and the slow and sometimes painful way in which the peculiarities of new materials are learned. These materials have been tried in a number of different plants under a variety of conditions, and they now feel that they have a good general purpose compound which will be well received in a number of fields.

Mr. Dent also reviewed the physical, chemical, and electrical properties of these materials. Chief among their advantages is an excellent dimensional stability, highly desirable where molded parts must fit together and where assembly must be completed later. Another advantage mentioned was length of flow in molding, which made it possible to mold large and complicated parts with a complete absence of flow lines.

These compounds, delivered in the form of dry, granular powders, have excellent shelf life, some batches having been stored for well over a year without change in physical properties. A variety of standard colors are now offered, and additional ones are expected to be made standard as they are required in sufficient quantities.

The following new members are welcomed into the Miami Valley Section:

Albert Drew, Bakelite; Howard L. Humphrey, National Cash Register; Leo T. Kruskamp, Dayton Plastics; Earl C. Sumner, The Duriron Company; Van J. Wolf, Cincinnati Milling Machine; Robert C. Gossling, Clopay Corp.; D. Saunders Threlkeld, Clopay Corp.; F. L. Miller, Rainville; Horace N. Phelps, Formica; V. E. Walsh, Hercules Powder; Philip H. Rhodes, Philip H. Rhodes & Associates.

Also welcomed into the section are the following transfer members:

From the Philadelphia Section: P. Willard Crane, Cincinnati Milling Machine.

From the Kentuckiana Section: Nicholas Carter, Cincinnati.

From the Central Ohio Section: Harry P. Holladay, Monsanto Chemical.

Five members from Plastics Research Products, Urbana, Ohio, have transferred their membership to the Central Ohio Section. These are:

Paul L. Caldwell, C. Richard Finley, Robert McCulla, Samuel Russell, Richard Stockton.

One member has transferred his membership to the Philadelphia Section. He is Robert Clark, Hercules Powder.

Airborne Electronics Symposium

The Southern California Section of the S.P.E. has announced that a symposium on "Plastics for Airborne Electronics" will be held in Los Angeles on November 11, 1957, at the Ambassador Hotel.

This RETEC will include such timely subjects as missiles and satellites, printed circuits and encapsulation, silicones and polyurethanes. Co-chairmen Leo Constanza and Bob Steinman expect an attendance of some 800 registrants. A preprint booklet will be prepared for those attending.

Committee on Encapsulation Invites Ideas From Members

A Committee on Encapsulation and a Committee on Printed Circuits have have been formed as part of the SPE Professional Activities Group. Most of us agree that these Committees can fill an existing gap in the SPE organization. The efforts to date have been primarily directed towards publicizing these Committees in an attempt to achieve the highest possible interest and potential participation in the groups before actually settling down to constructive projects. Now it is time to organize and set up specific objectives, and to begin working toward these objectives. For this reason, a meeting of each Committee will be held at the Hotel Statler in Boston, on June 13, 1957 at 1:30 P.M. You will note that this conveniently precedes the "Plastics for Electronics" symposium to be held by the New England SPE Sections on June 14 at Lowell Technological Institute.

Since the two subject Committees are just getting started, the actual activities in which we can engage are open and subject to the will of the group. We can, for instance, hold symposia or group discussion seminars of our own, or we can assist the Speakers Chairman of future Annual Technical Conferences in setting up sessions which are most interesting to us. We can also encourage and increase technical publications in our field in the leading technical journals, or we can establish a monthly problem and solution section in the SPE Journal. We can, perhaps, establish cooperative technical projects in common problem areas. All of these are just seed ideas. To bring out the fruit, make your arrangements now to attend the June 13 meeting in Boston. In the meantime, develop action plans which you feel most beneficial for the Committee with which you plan to affiliate. If you know of other persons interested, bring them along.

For further information write to C. A. Harper, Materials & Processes Engr., 052, Westinghouse Electric Cor., Air Arm Division, P. O. Box 746, Baltimore 3, Md.

Carlon Elects President

William L. Abramowitz has been elected president of The Carlon Products Corporation of Cleveland, Ohio, it was announced today (Wednesday, April 24th) by Brigham Britton, chairman of the board.

New York

Coloring of Plastics is Panel Topic

Jim Dugan

Over 160 members and guests attended the March 20 meeting of SPE's New York Section, which was held at the Governor Clinton Hotel in New York City. Theme for the meeting was "The Coloring of Plastics," and the program included a six-man panel of experts plus a movie entitled "This Is Color." Panel moderator was Fred Peterson, Westchester Plastics.

The movie, which described the physics of color, was shown first. Filmed by Interchemical Corp., it was explained in some detail by that firm's RBH Dispersions manager, R. L. Lynch.

R. H. Zabel, Du Pont pigments department, spoke on "Proper Application of Color." He discussed the inorganic pigment colors, which are usually incorporated mechanically since they have no solubility. These include the lead chromates, the ferrocyanides, iron & chromium oxides, cadmiums, and ultramarine blues. Organic colors were classified as azo-pigment dyes, which include the toluidene reds, hansa yellows, para reds, benzidine yellows, and others; the precipitated azo-pigments, such as the bons and the lithols; and the non-azos such as the acid-dye lakes, rhodamines, phthalocyanines, and the vat dyes.

Kenneth Roberts, Plastic Materials, Inc., spoke on "Hot-Compounded Colors," admitting that they were more expensive to purchase. He felt that many economies could be achieved in the long run, since they lower inventories, cut clean-down time, afford a greater richness of color, and offer exact color control.

Hal Felsher, Claremont Pigment Dispersion Corp., discussed the use of "Color Dispersions." Pre-colored masterbatches can be mixed directly with the material to obtain excellent effects such as outdoor-exposure resistance and absence of streaking. Anti-oxidants and traces of carbon black can be added to enhance these desirable features. Used with epoxies and polyesters, pigments must be light and heat-stable, have hiding power, tinting strength, and chemical inertness. Certain colors contain reducing agents such as lead and cobalt, which inhibit cure. Carbon blacks inhibit the catalyst.

Myles Schneider, American Molding Powder & Chemical Corp., had the topic "Hot-Compounding of Color into Vinyls and Polyethylene." Problems encountered with vinyl coloring involve price, the use of stabilizers, and the difficulty of matching a filled compound. Cheap fillers, such as calcium carbonate, tend to change color and opacity, and tri-base stabilizers tend to darken colors.

William Bradbury, Plastic Molders Supply Co., spoke on the "Dry Coloring of Thermoplastics." He pointed out that dry coloring eliminated one entire step of coloring— the extruding of color into plastics. Styrene is the material most commonly dry-colored, and accurate matches are obtained quickly. Inorganic pigments are best adapted to the method, since many organic dyes have a tendency to bleed. Soft pigments should be used in coloring copolymers and high-impact styrene in order to avoid differences in opacity.

OSAKA Section of SPE

Osaka Section, Japan, April 13th Meeting. Taken on the grounds of the Imbashi Club, where the meeting took place, first row, left to right: T. Nakai; M. Sakai (deputy for Mr. T. Fukumoto); Y. Fukuda, Vice Pres.; T. Nakao, National Dir.; K. Nakamori; K. Oshima, Pres.; K. Nakayama, Sect.; rear, left to right: S. Kitahara, S. Obata, K. Yoshida, K. Homma, Treas.; and T. Kokubo, candidate.

K. Nakayama

The Osaka Section's secretary, Mr. K. Nakayama of Chori Co., Ltd., reports that the Section held its April 13th meeting at the Imabashi Club, Osaka, Japan.

The Section now has seventeen members, with several new applicants for membership. Section officers are Mr. K. Oshima, President; Mr. Y. Fukuda, Vice President; Mr. K. Homma, Treas.; Mr. K. Nakayama, Sect.; and Mr. T. Nakao who serves as National Director.

Mr. K. Nakamori and Mr. Y. Fukuda will soon be touring the U.S.A. as members of the Japan Productivity Promotion Center's mission.

Peter Dornick Recovering

Peter Dornick of Spencer Chemical Co., is convalescing from a serious illness at Menorah Hospital, 50th and Rockhill Road, Kansas City, Missouri. Friends of Mr. Dornick may write to him at this address.

Plastics Institute Invites Members

The Plastics Institute, of 6, Mandeville Place, London, W.1., England, which was founded in 1931, publishes a quarterly "Transactions and Journal," and members of the Society may wish to consider whether they would like to become subscribers to this publication, or perhaps to become members of The Institute.

The annual subscription to the "Transactions and Journal" is £3 per annum for non-members. The membership fee for Ordinary Members is £3.30 per annum, and this entitles a person to receive the "Transactions and Journal" free of charge, and also, of course, such other literature as may be issued from time to time.

Further details may be obtained direct from the Secretary to Council at the above address.

Jakubek is Manager

Richard W. Jakubek has been appointed sales manager of the Strick Plastics Corp.

Southern California

Reinforcements For Plastics Other Than Glass Fibers

John A. Stahmann

The April 4th meeting of the Southern California Section was held at Scullys Restaurant. Mr. Don Hamilton presided over the meeting and Mr. Robert Steinman had control of the main program. Approximately ninety members and guests attended.

Mr. Elb Latham was the principal speaker of the evening. As the Laboratory Superintendent of the Sweldlow Plastics Company he is well qualified on the subject of reinforcements. In addition, Mr. Latham is the current Chairman of the Southern California Section of the American Chemical Society.

Mr. Latham started his talk by pointing out that fibrous materials are the basic strengthening agents for plastic laminates. Physical, electrical, and mechanical properties are improved by their use.

Physical and mechanical properties of fibers vary considerably. For example, the tensile strengths range from 12-17,000 psi for Vinyon HH to 100-136,000 for Fortisan. With the exception of some vinyl type compounds, most fibrous laminates are susceptible to ultra-violet attack.

Fibers may be classified as natural occurring or man-made materials, and further grouped according to the following table:

NATURAL	MAN-MADE
Animal	**Regenerated**
Wool	Cellulosics
Alpaca	Rayon
Cashmere	Cuprammonium Rayon
Silk	Saponified Acetate Rayon (Fortisan)
Vegetable	**Proteinics**
Cotton	Zein (Vicosa)
Flax	Marinova
Hemp	Ardile
Jute	**Synthetics**
Sisal	Nylon
Henequen	Acrylic (Acrilan, Dynel, Orlon)
Mineral	Acetate Rayon
Asbestos	Polyester (Dacron)
	Vinyl Chloride-Acetate (Vinyon HH)
	Vinylidene Chloride (Saran)
	Inorganic
	Glass
	Metal

Fibrous laminates may be formed by three methods. In the first method, a continuous layer of matted fiber is passed through the polymer, the excess metered off, and the product dried and cured as a sheet.

In the second technique, three dimensional objects are produced by making a preform of the cut fiber over a porous mold, adding resin, and curing the unit in a mold.

The third fabrication method is by casting, where the fiber is dispersed evenly in a pre-compounded mix.

Award to Dr. Robert Steinman

Because of his outstanding contributions to the plastics industry in the western states, Dr. Robert Steinman was given the "Western Plastics Award for 1957." This honor was based principally on his work with finishes and sizes for glass fibres, although he has made additional advances in the reinforced plastics field. The plaque was presented during a banquet of the S.P.I. held on March 20 at the Moulon Rouge.

The Southern California Section of the S.P.E. is particularly proud, since Dr. Steinman is quite active as program chairman for their group. He was also chairman for the recent Epoxy Symposium held at the section, which was an outstanding success.

The prior award was given to John Delmonte, of Furane Plastics in 1956. Mr. Delmonte's work on epoxy resin systems is nationally recognized. It is apparent that Dr. Steinman is in good company.

Northern Indiana

Delco-Remy Tour

Leon J. Page

On Monday, March 25, the Northern Indiana Section of the Society of Plastic Engineers were guests of the Delco-Remy Corporation of Anderson, Indiana.

They were joined by members and guests from other cities, which brought the attendance to 80 people.

After a welcome address by Mr. Eugene Quear and Mr. Clarence Tice, the group was taken to the company cafeteria by Mr. Fred Mullen of the public relations department for a very delicious buffet supper.

The remainder of the evening was devoted to conducted tours through a number of Delco Remy's plastic molding and manufacturing departments.

The following Farnsworth people were in attendance: W. G. Leichner, S.P.E. vice-president, and L. Hollopter, R. Pranger, L. Sieminski, E. Wood.

Central Indiana

Plastics Foams

C. R. Smith

Eighty guests and members attended a panel discussion of plastic foams at Central Indiana's April 30th meeting at the Warren Hotel. A broad segment of the industry was ably covered by three competent speakers.

Dr. E. E. Hardy, Research Director of Nesbay Chemical Co., talked on polyurethane foams. He illustrated the wide range of properties made possible in this versatile, rigid or flexible, foam through the use of different densities and special formulations. Though relatively a newcomer to this country it has already found wide commercial acceptance in many applications and new developments will undoubtedly create many more.

Mr. Calvin S. Yoren, Vice Pres. of Brown Rubber Co. in charge of Research and New Product Development, discussed vinyl foams. His discussion also covered both the rigid and flexible foams and pointed up the acceptance this product has already found in the automotive industry. As an experienced rubber man, Mr. Yoren was able to illustrate the advantages vinyl foams hold over latex and noted that public acceptance is such that the plastic foams are often mistakenly referred to as "foam rubber."

Mr. G. Richard Fransom of the Dow Chemical Co.'s Plastic Technical Service Dept., presented some interesting facts on styrene foams. One of the oldest commercially available rigid foams, this product is now available in pre-expanded stock, expandable beads and a combination of beads and epoxy resin. The well known pre-expanded stock has been used in many applications because of its excellent insulating qualities and now the expandable beads are finding wide usage in sandwich type construction for these same qualities. The newer beads and resin combination present an interesting quality since, with molding, the epoxy resin surfaces on the expanded beads imparting a hard, smooth exterior having the strengths and good adhesive qualities usually associated with that resin.

The inevitable question of comparative costs of these foams was unanswered at great length by the Panel, who pointed out that the difference in the properties of their products was such that in many cases they were not competitive, and at best it would require a complete study of processing and finishing of a specific item as well as material cost to establish which would represent the best economic picture.

Section Members were reminded to make plans in advance to attend the Annual Outing at the Lakeshore Country Club on June 14th, bigger and better than ever this year.

Pioneer Valley

Business' Role In Our Economy

Jack Perkins

The Pioneer Valley Section of the Society of Plastics Engineers had its monthly dinner meeting at the Wachusett Country Club in West Boylston, Massachusetts where 87 members were privileged to hear Mr. Paul R. Leach, Jr. of the Public Relations Department of E. I. du Pont de Nemours & Co. Mr. Leach is Eastern Manager of the Extension Division of E. I. DuPont Co. and is a former newspaper and Washington correspondent for a group of publications serving business and industry.

Future advances in the nation's standard of living will come about "only if we put behind them the full force of our entire business structure — the large, the small, the in-between," Mr. Leach said.

Such improvements are not created by law or legislation, he pointed out, but come about only to the extent that our industries and all our industries can continue to apply the same kind of bold and imaginative development which has proved so productive in the past. What we have in this country, the speaker went on to say, is not big business as distinct from small business, but a business community. This is a structure made up of all businesses so heavily intertwined and interlaced that each is a supporting element in the strength of the whole.

Attacks on business as a "special interest" are really maligning the entire American people where a great majority of us make our living in and through our business community. Mr. Leach illustrated how big and little businesses work together to raise the standard of living by showing how such commonplace things as nylon and cellophane get to the public and by discussing new developments such as silicon, which promises future improvements in American life. These improvements, he went on to say, require both big and little business. The large companies do the job of mass production, research, and development and the small companies carry on from there.

In the final analysis, the speaker pointed out that there is nothing so remarkable about big business. It is nothing more than a group of people who would ally themselves together to do things that are beyond the capabilities of a single individual or single group.

Discovery and development of nylon cost DuPont $27,000,000 and many years in time before it reached commercial production. Now 30,000 mills — mostly small — take the fiber and convert it into clothing, rugs, and other products for the consumer, the speaker said.

Thus each significant new basic material brought out by the big firm, gives the little business man just as much opportunity to grow and prosper. The little fellow cannot afford the research which brings us all the new things. The chain of reaction may begin with the large company, but it is taken on by thousands of other smaller firms, Mr. Leach said.

Although the small business may not compete directly with big companies in fields where heavy investment is required, they can come into their own in the complementary or secondary fabrication side of the industrial picture. Mr. Leach went on to say that for every basic steel, oil, chemical, and auto producer, there are small firms in each field that are fabricating goods from basics produced or supplying goods and services to their larger neighbors.

The meeting was followed by a question and answer period in which there were many lively discussions.

Upper Midwest

Ultra-Sonic Machining

F. W. Brown

Paul Becker opened the April 15 Upper Midwest Section Meeting by announcing the second Isocyanate Symposium to be held this coming October. The success of the meeting of last October prompted this repetition.

Russ Kirby, our Program Chairman, introduced our speaker, Richard Roney of the Sheffield Corporation. His topic was "Ultra-Sonic Machining of Cavities." Ultra-sonic machining is accomplished by energizing abrasive compounds with ultra-sonic waves. Only hard materials can be machined. The harder and more brittle the material, the faster the cut. A hardness of 60 Rockwell or higher is required for practical machining. Square holes can now be cut in diamond or sapphire. The Cavitron produced by the Sheffield Corporation operates at 20,000 cycles and employs abrasive of 240-280 grit size. Mr. Roney explained the functional parts of the machine with slides: the transducer, the magnetostrictive stack, the connective body, the tool holder, and the tool.

In the discussion period which followed the lecture, questions were asked concerning tool wear, machining tolerances and surface finish. Answers for these questions depend upon the material being cut. In tungsten carbide an accuracy of 1 to 2 mils is obtained on the first pass. Taper and minimum hole diameter are dependent upon the depth of hole. For hardened steel a surface finish of 15 micro-inches is obtained.

Ontario

Is Ounce Rating Valid As Guide?

J. J. Shehan

According to Robert Fehr, plastics machinery, Watson-Stillman Press Division Farrel-Birmingham Co., Inc. Roselle, N. J., it is no longer valid to give the size of an injection molding machine by its ounce ratings.

Mr. Fehr was guest speaker at the April meeting of the Society of Plastics Engineers, Ontario Section.

He talked about some of the recent developments in injection molding equipment and machines, and outlined some of the advantages and disadvantages of using preplasticizers.

Introduced to the meeting by Charles Seay, Eastman Chemical Products, Inc., Toronto, Mr. Fehr said it was misleading today to use the ounce ratings of machines as an indication of their size.

"A preplasticizer makes this rating invalid," he said.

Mr. Fehr outlined the development of the injection molding machine. He said that in the '30's a 2 oz. machine was quite a phenomenal unit. "In the '40's we got up to a 40 oz. and today we are talking about 500-oz. machines."

Today the trend is toward specialization. In selecting a machine you should know what you intend to mold. You should know the stroke and the opening requirements and whether it will be a conventional or a preplasticizing machine.

In the conventional machines a 48 oz. is a large sized machine. A preplasticizer equals a second injection unit and in most instances it charges while you are curing the previous shots, also, with a plasticizer you get increased production. He said that a 16 oz. machine with a preplasticizer added would have a maximum shot capacity of 48 oz. A 48 oz. machine with a preplasticizer would be 200 oz.

The preplasticizers are equipped with a series of check valves which prevents the material from flowing back into the preplasticizer cylinder.

Mr. Fehr illustrated his talk with several pictures and diagrams. One of these pictures was of an injection molded refrigerator door panel. Another was of a low pressure linear polyethylene dishpan. He said 138 dishpans an hour were turned out on one machine with an injection pressure of 11,000 lbs.

In the future he said that larger machines will be built with specific requirements. These machines will be built in four sections; speed plasticizer, area of parts, etc.

He answered many questions, such as "Have you something to measure the weight?" ("Yes!") "Is the torpedo of the spreader in the shooting cylinder?" ("No!".)

Cleveland-Akron

Understanding Is Important

Robert L. Larsen

By the time this article goes to press many will have forgotten the night of April 8th, but a little reminder may be in order; for this was the scheduled meeting night for the Cleveland-Akron, SPE, to be held at the Spanish Tavern in Brecksville.

A late blizzard blew up and by evening there was 12 to 15 inches of snow and still blowing. For a time it was questionable whether more than six would be in attendance, but about the second round, the attendance began to grow by two every five minutes, so that by 8 p.m., we had twenty-one of the most rugged individuals in the area and the meeting was called to order by President Ed Campi of International Molded Plastics.

After an enjoyable dinner, Mr. Saul M. Silverstein, who is secretary of the Council for International Progress in Management, was introduced as our speaker, and spoke on the subject, "Operation Understanding". A full report on this topic is written under section news, "Miami Valley", in the April issue of the SPE JOURNAL.

Much credit is to be given our speaker for making the meeting in spite of great odds and it thereby resulted in more of a round table discussion on various parts of his paper.

During the coffee break, Jim Jones, our Spring Dance chairman, gave out with the details for the forthcoming dance, (held at the Empire Room of the Hotel Cleveland on Saturday, May 11th). Doug Eaton, Reed-Prentice, our VP, who usually makes the meeting in 20 minutes but that night battled the same distance for two hours, reported our regular May 13th meeting which was to consist of a plant visitation to the Hoover Co., in North Canton, Ohio. Robert (Bob) Hershey, our program chairman, was reported to have had an accident on his way to the meeting. Ed Haskins drove from his plant, Zenith Plastics, for an hour and a half, ran out of gas and then because of power failure in the area couldn't even buy gas.—E for effort, Ed—.

During June the Cleveland-Akron Section will hold a regular meeting June 10th. Topic—progress and design in reinforced plastics, by Mr. J. E. Stokes, Bakelite Company; and elastomer cellular materials, by Mr. T. A. Rogers, Goodyear Tire & Rubber Co.

JUNE 21—Friday—Annual S.P.E. golf outing, at Aurora Country Club.

Don't forget—October 17th. Regional Technical Conference — Polyethylene.

Kansas City

Extruding and Molding Nylon

K. A. Kaufmann

The May meeting of the Kansas City Section of The Society of Plastics Engineers took place on the evening of May 7 at Milleman's Restaurant on the Plaza.

The main speaker of the evening was Mr. Robert L. Hughes of Spencer Chemical Company on the subject of "Injection Molding and Extrusion of Nylon 6."

Mr. Hughes noted that nylon resins have been developed in the last year or so with a marked increase in melt viscosity; are viscous enough to be handled much like other thermoplastics. This is especially important in extrusion applications for nylon because it opens up potentially large markets for nylon film, pipe, profiles, and sheet.

The largest volume nylons used today are the so-called 6 and 66 types. They differ mainly in chemical chain structure. Other nylons such as the 610, 611, or 8 types are made for specialized uses. Spencer Nylon is a 6-type nylon.

The market has grown from two million pounds in 1950 to seventeen and one-half million in 1956. Probably 90% of the consumption in 1956 was injection molding, and most of the molding was in small parts weighing two or three ounces. With the advent of the high viscosity extrusion grades of nylon, it is expected the extrusion market will catch up with the molding market by 1960.

The basic physical properties of Spencer Nylon are very little different than those of nylon 66. The basic differences are slightly greater flexibility and impact strength, and slightly lower surface hardness for the nylon 6.

As is true with the other thermo-

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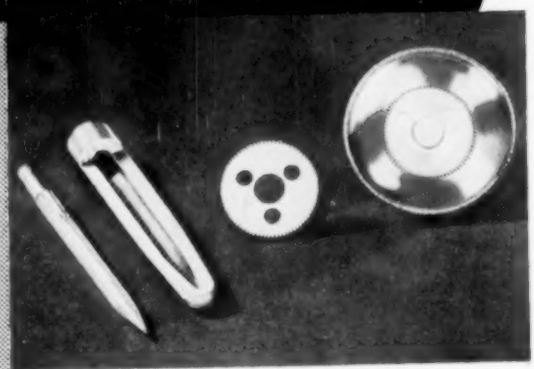

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plastics it is necessary to be familiar with the melting characteristics of 6-type nylon to mold or extrude it satisfactorily. In addition to the higher viscosity of Nylon 6 at melt temperature it has a broader processing range.

When injection molding Spencer Nylon the cylinder heats will depend on the cycle and shot size. Shots as high as one pound are easily moldable with nylon 6. Usually the melt temperature should be 35-45°F above the melting point, which is 425°F. In practice, the cylinder temperatures will then vary from 470-520°F for most molding jobs. Fast ram speeds should be used. Mold temperatures have a decided effect on the properties of the molded piece. This is especially true in thin sections. Cold molds give an amorphous part with excellent transparency and toughness. Hot molds result in a crystalline material with increased stiffness and hardness.

Until recently the use of nylon in extrusion has been limited to abrasion resistant sheaths on electrical wire and small diameter tubing because of the fluidity of the nylon melt. With the high melt viscosity resins now available, pipe, profiles, blown and flat film, and sheet may all be made from nylon using equipment and techniques similar to those used with polyethylene, acetate, and rigid vinyl. Centrifugal casting and extrusion molding are also easily accomplished with Spencer Nylon.

To summarize, nylon resins can now be molded and extruded with a minimum amount of special equipment. The resin is expensive, but the strength, abrasion, heat, and chemical resistance will justify the cost in many applications. Nylon is extremely competitive with die-cast zinc right now. Nylon extrusion applications will grow now that these high viscosity resins are available. We expect the extrusion market to catch up quickly with the injection molding market.

Small Problem

How do they do it? What we mean is, how on earth do they make those ink bottles with the little well on the inside?

And if you can figure how it's done with glass, than maybe you can figure out how to mold a thing like this in plastic. Why not give the problem some thought, "just for drill" as the boys say. If you have any ideas or suggestions, let us know. We may even offer a cigar for the best solution.

A very pretty problem.

New England

Polyethylene Uses Topic

Charles P. Pechulis

Two combined meetings of the New England Section of the SPI and the Eastern New England Section of SPE were held in the month of April.

On April 18th, after a smorgasbord dinner at the Hotel Beaconsfield in Boston, a panel discussion was held on the "Applications and Merchandising of the Polyethylene Bottle", with Mr. Art Staff of Koppers Company, Inc, as moderator.

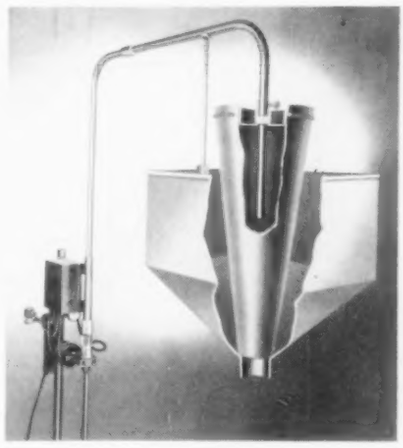
The panel consisted of: Mr. W. Ward Willett of the Bradley Container Corporation who outlined the "Squeeze to Use" bottles as used in packaging of paste form products, such as soft cheese spreads, toothpaste, and condiments. Mr. James H. Parliman of Plax Corporation who spoke on the permeability qualities and the research of internal liners for organic solvent based liquids. Mr. George Pickering of the Lamex Chemical Corporation who gave a resumé on the end uses of the blow-molded bottles and their functions as to squeezability, chemical reaction, and nonbreakability. Samples of the various designs were presented by the three speakers and the meeting ended with an open forum.

On April 25th a dinner meeting was held at the Maridor Restaurant by the Eastern New England Section of SPE and the Boston-Providence Chapter of the SPI.

Mr. Joseph Clancy of Emery Industries opened the meeting with the introduction of Mr. Julian Paul who is associated with the Carbide and Carbon Chemical Company. Mr. Paul gave a review of Vinyl Plasticizer Technology and its effects caused by mixed plasticizer systems.

The next speakers for the evening were Mr. Samuel Ayers, president of the Samuel Ayers, Jr., Associates and his assistant, Mr. Wallace A. Underwood. The topic was the "Designers Viewpoint on Plastic Applications". In this discussion they covered the proper choice of materials and fabrication methods, choice of plastics versus other materials, relation of production to merchandising, sales requirements, and current product design trends.

The meeting ended with an open forum.



NEW!

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HANDLES DUSTY DRY-COLORED MATERIALS

It consists of a conical shaped filter which is attached to the end of the conveyor tube of the Whitlock Hopper Loader and extends down into the throat of the hopper. In operation, the filter cone is automatically kept filled about half full of material. As the material passes through, the upper part of the cone acts as a filter. The filter cones are replaceable at small cost.

Additional Information on Request

C. H. WHITLOCK ASSOCIATES

21657 Coolidge Highway Oak Park 37, Mich.

frankly SPE aking

THE SUBJECT OF TAXES is very much in the news these days, and we hear at least two very different thoughts about the subject. One group seems to think that the public is not interested in reducing taxes, but that they prefer to have them increased so that more and more services can be provided. The other group seems to think that MOST taxes should be assessed at the local level and that all possible effort should be made to provide needed services at the local level. I believe this latter is generally referred to as "home rule." Our tax money that goes to Washington, goes through a great many hands and eventually some of it may come back to us. As engineers, we are all well aware of the law of hydraulics, which says that if we put enough elbows and couplings in a pipeline, the pressure will be so greatly reduced that only a trickle will come out of the far end of the pipe. This trickle of tax money that comes back to our community should be proof that we have too many "elbows" and "couplings" in the tax pipeline.

Daily papers frequently report that some politician says "Let's build something because Federal money will finance 50% of the project," — the implication being that Federal money is "free."

I think perhaps we might be able to devise some simple tests to determine whether **you** are interested in tax reduction or not. I am just old enough to remember that most of our township roads in Indiana were improved by residents of the community "working out" their poll taxes. As I recall, this was at the rate of $1.50 per day for a man with a shovel, and $3.00 per day for a man with a team and wagon, which meant that each male citizen over 21 years old would have to give at least one day's service in hauling to improve the roads in his immediate vicinity. Maybe we have come a little far to do this same thing now, but perhaps we have other things that we can do. For example, if a limb falls out of a tree in front of your home, do you shove it out into the gutter and wait for the City to pick it up, or do you cut it up into small pieces and haul it to the dump yourself, or perhaps burn it in your back yard in your incinerator? Is there broken glass in your alley? If there is, I'll bet you have said: "I wish the City could send its street sweeper down this alley and clean it up." My suggestion is that thirty minutes of work by each property owner would clean up the alley, and save a considerable sum of tax money. These are only a couple of examples, but I am sure that you can add many more to them.

Yours for better living with Plastics,
Wayne I. Pribble

Newark

New Concepts In Molding Thermosets

Robert A. White

The entire program for the April 10th meeting of the Newark Section was devoted to the presentation of New Concepts in Compression and Transfer Molding of Thermosetting Materials. The speaker for the evening, Mr. Edward F. Boro, Supervisor of Technical Service, Molding Compounds, Durez Plastics Division of Hooker Electrochemical Co., was introduced to the assembly as the Dean of Compression Molding.

Mr. Boro, who has been associated with the plastic industry since 1923, expressed confidence in the continued growth of phenolic molding compounds. In referring to the 100% increase in the use of phenolic molding materials during the past 10 year period, Mr. Boro indicated that future progression will be at a slower rate than the more glamorous injection molding material, polyethylene. He emphasized that continued pursuit of new applications is necessary and that the approach to these applications should be intelligently made. A major contribution to this growth is the non-ending research and development effort by material suppliers to meet the demand for specialty fields. In servicing the needs of the molding industry, Mr. Boro has found that a critical factor is the misuse of materials by the molder. Selection of proper compound based on consideration of the more important criteria of the application, is one of the primary requisites for a successful end product. He stated that in the general purpose class of phenolics, there are 24 different compounds. Each class, such as Impact or Dielectric materials have as many or more different compounds. These can be 1 or 2 step materials. The one step being ammonia free but due to after curing requires a post cure. The two stage materials are prone to cracking in the presence of moisture.

Basic principles of mold wear, volume electronic preheating and case hardening conditions were presented along with a most interesting discussion on insert gating for mold wear in transfer molding.

The meeting was conducted by Section President Bob Hoehn who spoke briefly on the Annual Section Outing being held during June. 87 members and guests were in attendance.

Danger in the Plant . . . (from page 114)

2. Prolong the life of hoses by placing them on reels. This will also eliminate tripping hazards.
3. Establish definite rules for persons who may use compressed air and insist upon strict compliance.
4. Provide safety glasses.
5. Teach employees to respect the power of compressed air. Use posters and other visual and educational material to warn them of the dangers of misuse. 'Instructions to employees should include the following.
   (a) While turning air on or off, hold air hose clear to the free end.
   (b) Do not lay hose down while there is pressure in it as it might whip about and strike someone.
   (c) Be sure air is turned off at valve when air hose is not in use; this prolongs the life of the hose.
   (d) Shut off air before repairing air tools.
   (e) Do not use air to dust off hair or clothing.
   (f) Use eye protectors when using hose.
   (g) Never point air nozzle at anyone or attempt practical jokes.
   (h) Do not sweep floor with air.
   (i) Inspect air hoses regularly.
   (j) Do not use compressed air to transfer oils, chemicals, or other liquids from drums or any other containers.

Machinery Room

The air compressor and vacuum pumps are of a rotary nature and exposed flywheels and belts must be adequately guarded in approved fashion. These service machines should be isolated in a separate room, free from dirt and dust.

The high pressure boiler, in order to comply with carriers insures proper devices, controls and condition of boiler satisfactory to safe operation. Over-loading of boiler by installation of larger tips or setting controls and safety valves to exceed safe working pressures should never to permitted. Boiler and associated equipment should be operated and maintained by trained service personnel.

book reviews

VACUUM DEPOSITION OF THIN FILMS

by L. Holland, Published by John Wiley, Price $10, 566 Pages

I consider this publication one of the most valuable works that have ever been compiled on the subject of vacuum evaporation. My enthusiasm stems from the fact that the book is written in a style which will appeal to the layman as well as the scientist. There are many other very favorable publications on the subject of high vacuum in which certain sections deal with the evaporation of thin films. However, all other publications, to my knowledge, go heavily into the "theory" of vacuum techniques to such an extent that there is little interest on the part of the layman.

Mr. Holland covers both the technical and the practical aspects of high vacuum evaporation. This book should be of tremendous interest to anyone engaged in the vacuum metallizing process which covers the deposition of metal on plastics or metal parts. Mr. Holland covers the subject very thoroughly and explains many of the problems that exist concerning curing of lacquers, long pumping cycles in humid weather, the effect of glow discharge, and many other "down-to-earth" aspects associated with this fascinating process. He writes in a style which is easy to understand and I firmly believe that every foreman, production manager, and "scientist" associated with vacuum plating should read this book to acquaint himself with the fundamental aspects.

Vacuum plating is considered a "mystery" in many circles and Mr. Holland has contributed substantially to the resolving of many of the theoretical dissertations which have existed to date.

In addition to his excellent treatise on the subject of vacuum evaporation in a layman's language, Mr. Holland has also included a few "long hair" chapters which should delight the theorists and mathematicians. Basically, however, the book is exceptionally easy to read and anyone genuinely interested in the subject will find it difficult to put the book down.

I heartily recommend this excellent work on the "Vacuum Deposition of Thin Films" by L. Holland.

J. Gordon Seiter

HANDBOOK OF SOLVENTS, VOL. I.

by Ibert Mellan, Reinhold Publishing Corporation, New York. Price $6.75, 249 Pages

This book, as stated in the preface, is the first in a series designed to give adequate coverage of such a broad subject as solvents.

Volume I deals with hydrocarbon solvents. As is the expressed intent of the author, a system of classifying and relating solvents by their distillation range was chosen. Thus, solvents more nearly alike in solvent properties are closely aligned making the task of selection easier and the correction selection more probable. To assist in this, the composition and evaporation rates are also included. For each solvent a full data sheet is given. The

(Please turn to Page 146)

Modulation

For Modulene and Super Modulene virgin polyethylene.
For low cost, high quality reprocessed plastics: polyethylene, polystyrene, vinyl, butyrate, acetate.

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Book Reviews . . .

(from page 145)

author uses trade and commercial names for identification of solvents.

The book contains an excellent introduction on the subject of hydrocarbon solvents, their derivations and general properties. A lengthy chapter is devoted (mostly in data form) to aliphatic hydrocarbons, aromatic hydrocarbons, and terpenes.

This book together with successive volumes should make an excellent and complete solvent reference for a library.

J. C. Stansel

Textbook of Polymer Chemistry

Fred W. Billmeyer, Jr. Interscience Publishers, Inc., 250 Fifth Ave., New York City. 518 pages, $10.50.

A quotation from the preface establishes the scope and purpose of the book—

This book was written as a textbook in the organic and physical chemistry of high polymers. It includes no original work, but is an attempt to gather into one location and to classify some of the more interesting and important information about polymeric substances. It is based entirely on previously published information.

The book was written for use with graduate-level courses in the chemistry of high polymers given at the University of Delaware. It is intended that the text be expanded in lectures and supplemented by reading assignments taken from the works listed under General References at the end of each chapter. Details of these phases are left to the discretion of the instructor.

At present the text is used with four two-hour courses of one term each, roughly: Physical Chemistry of Polymers, Chapters 1-18; Kinetics of Polymerization, Chapters 19-31; Plastics, Chapters 1, 2, 32-43; and Fibers and Elastomers, Chapters 1-2, 44-57. In the lectures accompanying the Plastics and Fibers and Elastomers courses, reference is made to material in Chapters 3-7. Suitable arrangement of the material can easily be made to cover the subject matter in the text in one or two one-term courses.

The book is written for the senior or graduate student who has had courses or informal training in organic and physical chemistry, elementary physics, and mathematics through elementary calculus. No prior knowledge of high polymers is assumed.

The book does an excellent job of reaching its objective and marks a high point as a practical textbook. The discussions are mainly about physical chemical methods of studying polymerization processes and structures, and will be largely familiar to the plastics chemist.

The treatment of specific polymers is limited but will serve as an adequate introduction to principal types.

Textbook of Polymer Chemistry will be of some interest to the chemist entering the polmer field, or as a general review of fundamentals for the practicing plastics chemist. For the plastics molder seeking a readable source from which to learn more about why plastics behave as they do, the Textbook will do the job if the reader has some college chemistry background.

As a college text for a first course in polymer chemistry, this book is highly recommended.

Jesse H. Day

(Please turn to page 148)

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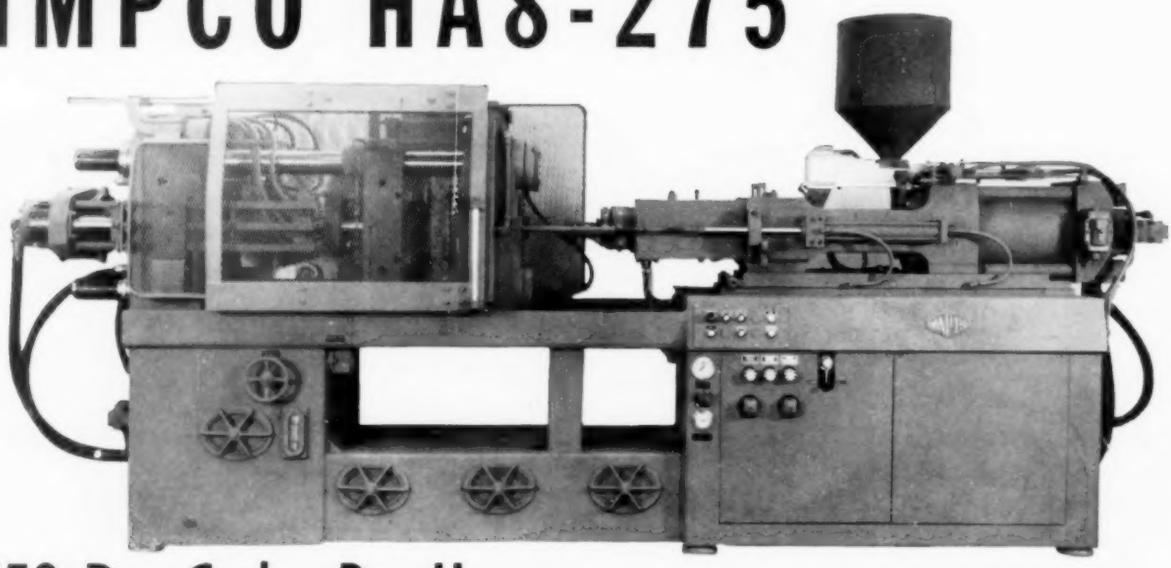

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Molding Cycles . . .

(Continued from Page 124)

Cavities

Is the number of cavities limiting the flexibility of the machine with respect to:

(a) Clamp capacity and pressure? Too many cavities may result in flashing or necessitate molding at insufficient pressure or excessively high temperature.

(b) Rate of injection and quality? When the parts being molded require a high rate of injection a large number of cavities may result in erratic and slow filling, thus affecting quality.

(c) Production, melt capacity or cycle?
Cycle should be limited only by the production of satisfactory parts, not by the quantity of melt available to fill the mold. Recognizing that economic factors dictate utilizing as much as possible of the melt capacity of the molding machine, the machine will yield more pounds per hour if, for example, the shot weight is ½ the rated capacity of the machine rather than full capacity provided, of course, that the mold can best be operated on a shorter cycle. The number of cavities should not be so great as to necessitate lengthening the cycle in order to obtain sufficient molten material to fill the mold.

With respect to cavities, the following should also be checked.

1. Is the layout well balanced?
2. Are cavities well supported to prevent yielding of the cavity plates?
3. Is venting provided for and adequate?
4. Will ejection be positive or likely to be erratic?
5. Are components well cored to insure uniform temperature control?
6. Should part design be modified slightly to improve quality or performance of the molding operation?

Careful consideration of the above factors when planning the mold can result in real cost savings — not only in avoiding the expense of altering the completed mold, but also in providing a tool that will operate at optimum efficiency.

Management Seminar

An Organization Management Seminar will be held June 22-28 at Michigan State University, East Lansing, Michigan. Sessions will include Group Leadership, Ethics, Motivation, Cybernetics, New Horizons in Economic Thought, and discussions of the Case Method. For further information write to Spencer Shaw, 38 S. Dearborn St., Chicago 3, Illinois.

Improved **all around** for **all-round** use . . .

Out of Durez research and testing laboratories has come an important new molding compound—an improved-all-around version of our famous "792."

Molders, designers, engineers, and production men are finding in this material a unique combination of properties at the cost of a general-purpose phenolic.

Heat-resistance is exceptional for a material of its class: when properly molded, "792" successfully withstands in appearance and physical properties a heat treatment of 72 hours at 200°C. (392°F.). Its above-average *insulating properties* are matched by resistance to *prolonged high humidity.*

Dimensional stability is improved over other general-purpose phenolics. These properties, added to its durable high surface gloss, make "792" a most versatile material for applications ranging from camera parts to electronic tube bases, electrical components, and utensil handles. Three granulations include one for preheating volumetric charge for automatic molding equipment. Let us send you a trial shipment and full data.

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From a cold start through a full production run, Sterlco's "fast service" and extremely high degree of sensitivity assure quick warm-up and accurate, automatic mold temperature control for faster production and minimum rejects.

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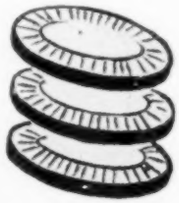

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Book Reviews . . .

(Continued from Page 146)

Symposium on Speed Testing Non-Metallic Materials

ASTM Special Technical Publications No. 185; presented at the 58th Annual meeting; Atlantic City, New Jersey, June 29, 1955.

The series of papers presented included work on glass, concrete, rubber-elastomers, wood-wood base materials, paper, yarns and synthetic plastics. The proper and economic application of these materials in our expanding consumption of all materials of fabrication is dependent on precise and complete performance data. The lack of such data either limits the useful application of materials or relegates action to costly "Cut and Try" methods.

The interest in these reports to those concerned with product application and development should be obvious, be they laboratory or field engineering personnel. Briefly reported, the following papers are presented in the publication.

1. "The Influence of Rate of Loading on the Strength of Wood and Wood Base Materials", L. J. Markwardt and J. A. Liska.
   Work reported includes—effect of rate of loading on the compression parallel to grain.
2. "The Effect of Speed of Testing on Glass." H. N. Ritland
   Includes the structural changes of importance at annealing temperatures and surface defects giving rise to delayed fracture at ordinary temperatures.
3. "The Effects of Speed in the Mechanical Testing of Plastics Testing." A. G. H. Dietz and F. J. McGarry
   Examines the thesis; time-dependance on sensitivity of plastics mechanical behavior can be found in their molecular structure.
4. "Stress-Strain relationships in Yarns Subjected to Rapid Impact Loading." H. F. Shiefer et. al.
   High speed motion picture recording of Nylon and Regenerated cellulose yarns testing is reviewed.
5. Effect of Speed of Testing on the Tension Test of Elastomers and Hard Rubber." D. C. Scott, Jr., and D. S. Villars.
   Results of testing on GR-1, GR-S and hard rubbers presented with conclusions as regards rate-dependant factors.
6. "Review of Data on Effect of Speed in Mechanical Testing of Concrete." D. Henry and J. J. Shideler.
   Discusses current test specifications with respect to compression strength, flexural strength and modulus of elasticity.
7. "Notes on Effect of Speed of Testing on Tensile Strength and Elongation of Paper." R. E. Green.

R. R. Moyer

Products from Coal

The Barrett chart "Products Derived From Coal" has been in perennial demand over a great many years by technical people in all type industries as well as faculty and students in schools and universities.

The latest edition of this famed chart has just been issued by Barrett Division, Allied Chemical & Dye Corporation. This copyrighted chart is more complete than ever before and contains a large number of derivatives not mentioned in previous issues.

SPE members interested in obtaining a copy of the chart, can write to Barrett at 40 Rector Street, New York.

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- By the tank car from Hopewell, Va.

If you use cyclic ketone solvents, you'll appreciate the quality and performance of National NADONE. It is the highest-quality cyclohexanone ever offered . . . minimum purity 99.0%.

Made in the industry's newest plant by a direct process with basic materials from within the Allied Chemical group, National NADONE is an excellent solvent and resin intermediate.

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Write for 24-page Technical Bulletin I-19 giving detailed data and for working samples, prices and delivery quotations.

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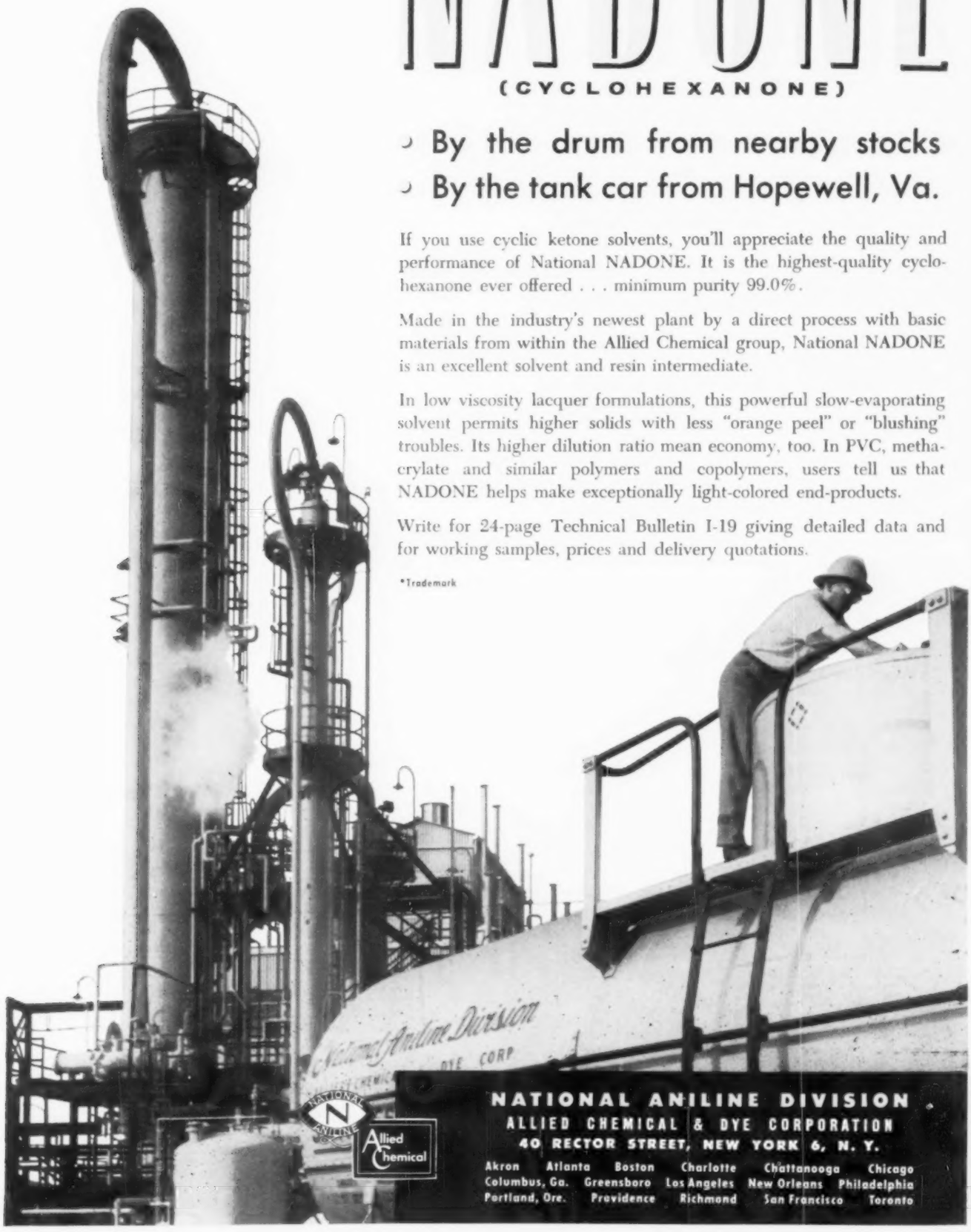

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Sales Representative Wanted

Experienced sales representative, energetic, resourceful — commission basis — for old established firm in Southeast. Territory unrestricted. Primarily for compression and transfer molding. Must be aversed in parts design, various materials, with proper applications. Permissible to have other representations that are not conflicting. Excellent opportunity for right man. Replies held confidential. Box 1657, SPE Journal, 34 E. Putnam Ave., Greenwich, Conn.

Faculty Position Open

ACADEMIC POSITION — Faculty position in Plastics Technology and Processing for September 1957. Rank and salary dependent on qualifications. Teaching and industrial experience desirable. Send information regarding educational background, experience, personal data, and references in first letter. Plastics Eng. Dept., Lowell, Technological Institute, Lowell, Mass.

Injection Machine

FOR SALE 1—HPM—16 oz. Injection Machine Serial No. 51-271 with two Xactline Controls for Wheelco Instruments. Also 2 spare Pumps and 1 spare IMS 16 oz. Heating Cylinder. Equipment in excellent condition and can be seen at any time. Submit offer. Reply Box 1757, SPE JOURNAL, 34 E. Putnam Ave., Greenwich, Conn.

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Wanted: Research & promotion man in thermoplastics with sales ability by large, expanding national manufacturer, Middle West.

Excellent salary and future. Box No. 1857, SPE JOURNAL, 34 E. Putnam Ave., Greenwich, Conn.

Plastic Finishing Foreman

Leading Chicago area injection molder requires general foreman for finishing operations, including painting, silk screening, hot stamping, etc.; also assembly. Permanent position for man with experience to operate this expanding department. All replies confidential. Salary and Profit Sharing, commensurate with ability. Box 1957, SPE JOURNAL, 34 E. Putnam Ave., Greenwich, Conn.

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American Cyanamid Company has several vacancies in its East Coast Development and Technical Service Molding Shops.

Technicians or Engineers may qualify with 3-10 years of experience in any, or all, of the following:

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Please submit complete resume including education, experience and salary desired. Daily interviews.

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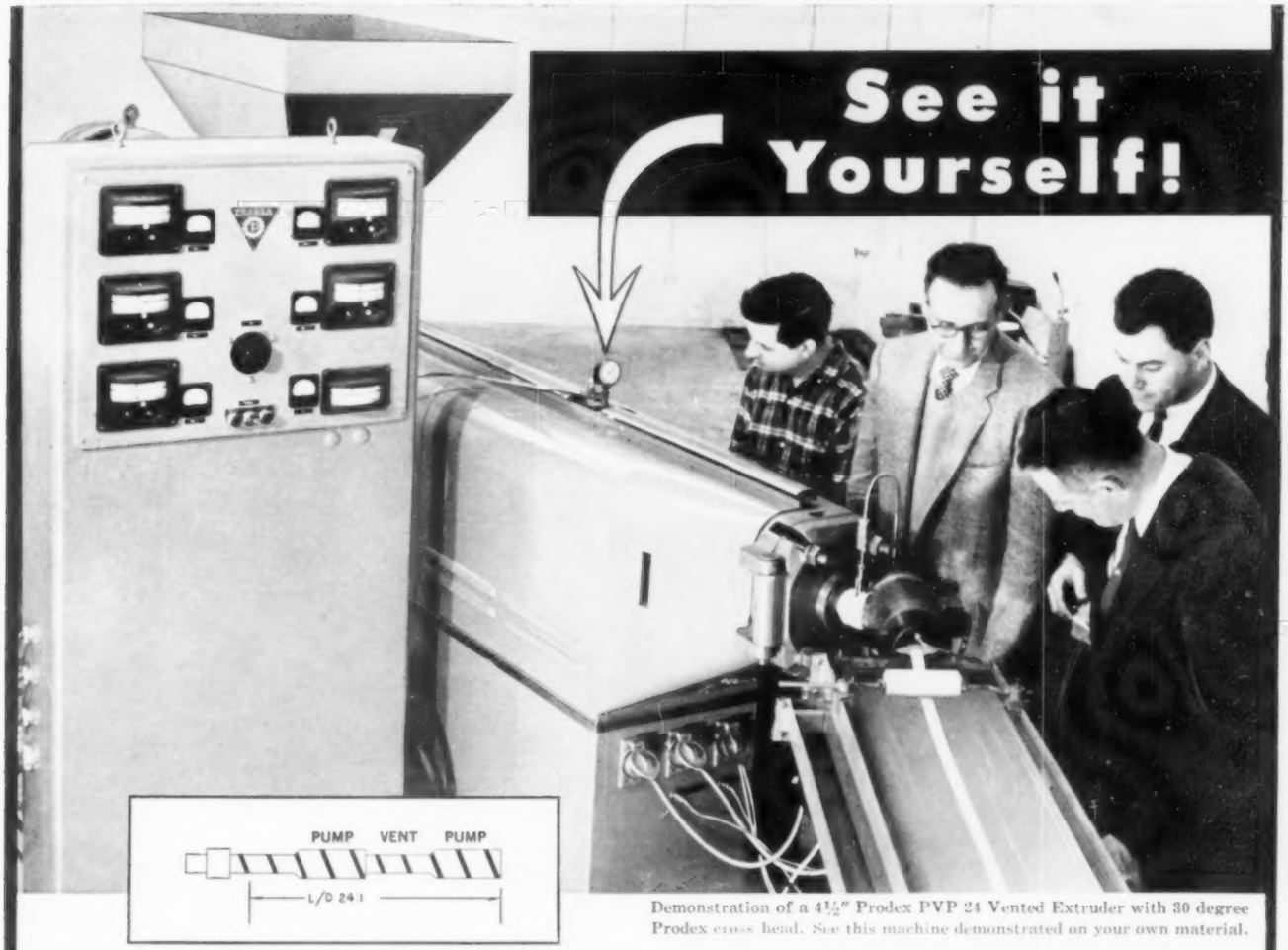


Demonstration of a 4½" Prodex PVP 24 Vented Extruder with 30 degree Prodex cross head. See this machine demonstrated on your own material.

A demonstration proves the superior performance of the Prodex PVP 24 Extruder

The unique Prodex PVP 24 Extruder plasticizes the compound to a uniform melt viscosity. The material is then positively pumped into a devolatizing section where moisture, monomers, air, etc. are removed. A second pump positively meters the compound into the die. This combined action—**Eliminates Porosity—Increases Output—Improves Dispersion—Eliminates Pre-Drying—Reduces Heat Degradation—Improves Precision.**

Typical Production Rates of Prodex PVP 24 Extruders

Extruder Size	Drive H.P.	Cross Section	POUNDS PER HOUR		
			PVC Dryblend	Polyethylene Pipe Cpd.	Polystyrene High Impact
2½"	20	.11 sq. in.	180-240	150-180	150-240
4½"	60	.25 sq. in.	550-660	450-520	500-630
8"	200	1.00 sq. in.	1700-2100	1450-1600	1500-1900

No porosity was present in any of the above extrusions. All compounds contained at least 1% moisture and were not extrudable on ordinary machines without porosity. All rates at precision tolerances.

Prodex PVP 24 Extruders are available in 1¾", 2½", 3½", 4½", 6", 8" sizes.

Arrange for a Demonstration Today

Let us prove to you the outstanding performance of the Prodex PVP 24 on your own material or write for bulletin E-4 today.

PRODEX

PRODEX EXTRUDERS

PRODEX CORPORATION, FORDS, N. J., HILLCREST 2-2800

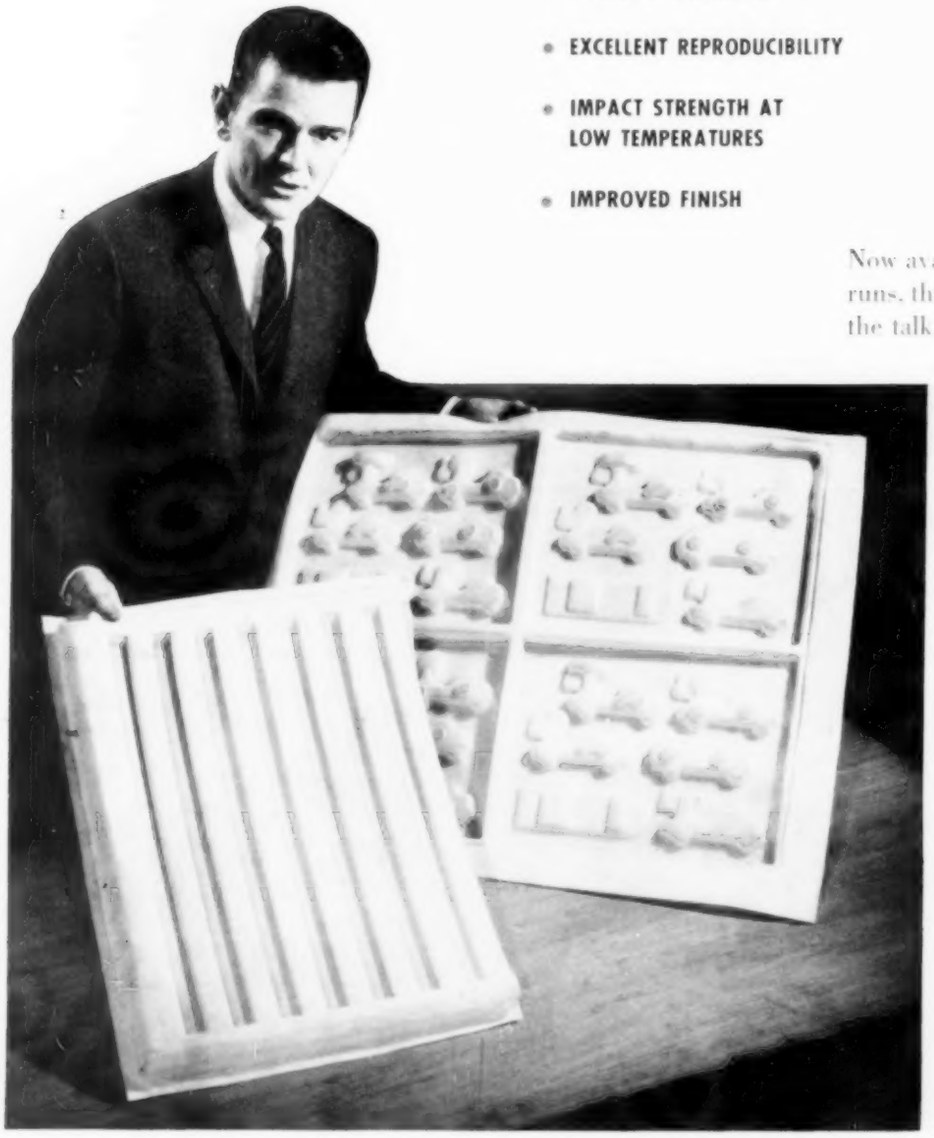
MANUFACTURERS OF PROCESS AND EXTRUSION MACHINERY

hi-fax® Vacuum-Forming 'Natural'

HI-FAX— This new linear ethylene polymer offers you a combination of properties for vacuum-forming never before available in a low-cost plastic. Here's what Hi-fax sheeting for vacuum-forming offers:

- RIGIDITY AND TOUGHNESS IN LARGE SECTIONS
- TEMPERATURE RESISTANCE —CAN BE STERILIZED
- EXCELLENT REPRODUCIBILITY
- IMPACT STRENGTH AT LOW TEMPERATURES
- IMPROVED FINISH
- TRANSLUCENCY IN A WIDE COLOR RANGE
- GOOD ELECTRICAL PROPERTIES
- CHEMICAL RESISTANCE
- LOW MOISTURE PERMEABILITY

Now available for commercial production runs, this new Hercules material is already the talk of the plastics industry!



BIGGER AND MANY WAYS BETTER—The four-cavity toy package and a light diffuser panel shown here were both vacuum-formed with Hi-fax sheeting manufactured by Gering Products, Inc., Kenilworth, New Jersey. Light diffuser was manufactured by Tiger Plastics, Brooklyn, New York; Toy package by Vacuum Molding, Inc., Boonton, New Jersey.

HERCULES

Cellulose Products Department

HERCULES POWDER COMPANY

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